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SUMMARY OF CURRENT RESEARCHES IN ZOOLOGY, BOTANY,
MICROSCOPY, AND INDUSTRIAL PROCESSES.

NOTICES OF NEW BOOKS. PROCEEDINGS OF THE SOCIETY.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

MARCH, 1927.

TRANSACTIONS OF THE SOCIETY.

I.—THE PRESIDENT'S ADDRESS:

NUCLEAR DEGENERATIONS FOLLOWING MULTIPOLAR
MITOTIC CELL-DIVISION.

By JAMES A. MURRAY, M.D., F.R.S., PRES.R.M.S.

(Read January 19, 1927.)

ONE PLATE AND EIGHT TEXT-FIGURES.

THE observations I am going to describe to you in this Presidential Address date back to the years 1905–1906, and were carried out on the material and in the laboratory of my friend and teacher the late Professor Theodor Boveri in Würzburg. I had the good fortune to work with Boveri in the earlier and the later phases of his scientific life, first in 1895–96, shortly after he was appointed to the Chair of Zoology in Würzburg on the death of Semper, and later in 1905 when he had entered on those brilliant researches in experimental cytology which have rendered him illustrious. They are a model of clear thinking and writing, coupled with a mastery of microscopic observation and manipulation which have elicited the enthusiastic admiration of biologists throughout the world.

To me Boveri always extended a personal kindness and consideration far beyond my deserts, and his death in 1915 at the age of fifty-three put a poignant end to a friendship which had lasted for twenty years.

The material on which the degenerations due to multipolar cell-division were studied was that provided by disperm fertilized sea-urchin eggs. Boveri showed (*Zellenstudien*, VI, 1907) that normal healthy eggs and sperms could give rise to pathological development if, instead of one, two spermatozoa entered the egg. A tri- or quadri-polar mitotic figure results

under these conditions, and the egg divides simultaneously into three or four primary blastomeres, after which segmentation proceeds normally by bipolar mitosis, practically till the blastula stage is reached. The course of the subsequent development shows great variations, and the monograph referred to is devoted to a closely reasoned, exhaustive analysis of the nature and significance of the abnormalities which occur. The conclusion to which a consideration of all the facts led was that, whereas in normal monosperm fertilization each cell of the resulting larva receives a complete set of chromosomes from each parent, in disperm fertilization the bipartition of each chromosome of the three sets of chromosomes

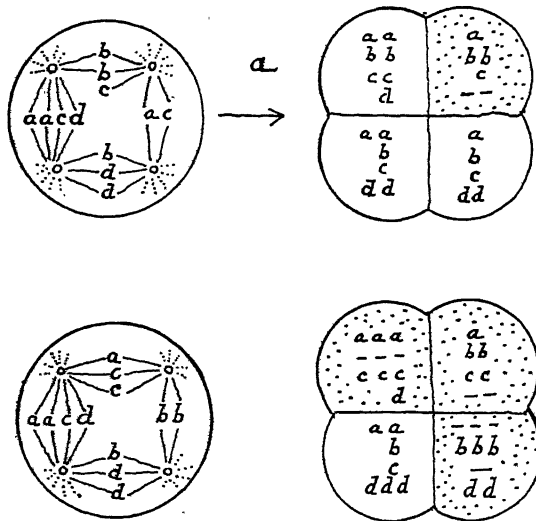


FIG. 1.—DIAGRAMMATIC REPRESENTATION of Boveri's conception of the production and nature of chromosome defect in disperm tetraaster echinoderm egg.

a—one of the 4 primary blastomeres defective.
b—3 of the 4 primary blastomeres defective.

(one from the egg, and one from each sperm nucleus) between three or four asters (and consequently between the three or four primary blastomeres) inevitably entails a fortuitous distribution of the daughter chromosomes, so that each cell does not necessarily receive even one complete set of chromosomes, and the varying abnormality of the descendants of the unequal blastomeres is a consequence of this faulty chromatin distribution. The diagrams (fig. 1) taken from Boveri will make the fundamental conception clear. Boveri showed by isolating the primary blastomeres (figs. 2, 5), as well as by a study of the larvæ which arise from the disperm eggs (figs. 3, 4, 6) if left to themselves, that the differences in the fate of the descendants of the primary blastomeres could be referred to their nuclear make-up alone, and with certainty. One of the most remarkable

Nuclear Degenerations following Multipolar Mitotic Cell-Division. 3

of the pathological derangements of development is exemplified in fig. 3, showing a pluteus larva in optical section. Here one sector of the body wall has broken up into single rounded separate cells and parted company

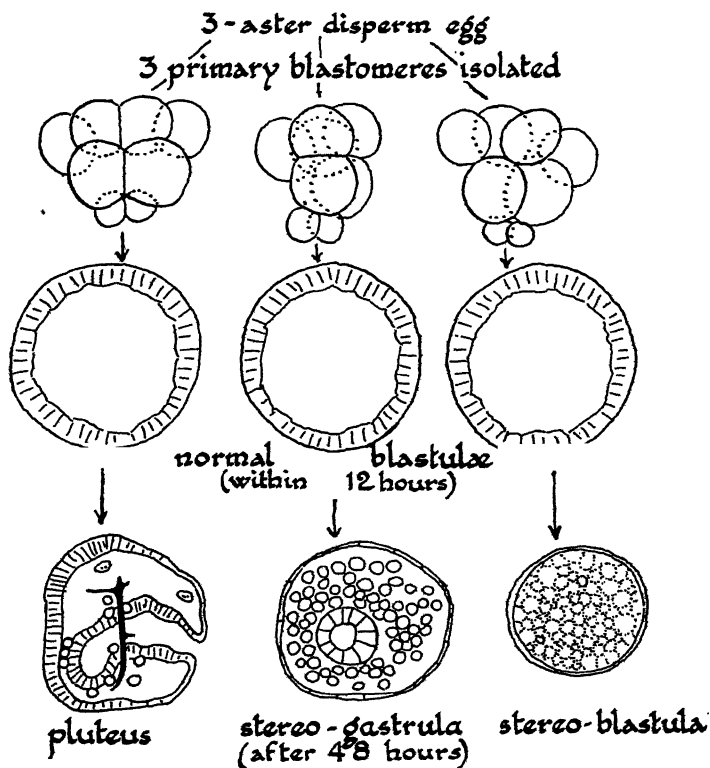


FIG. 2.—EARLY NORMAL DEVELOPMENT and varying pathological fate of the three isolated primary blastomeres of a triaster disperm echinoderm egg.

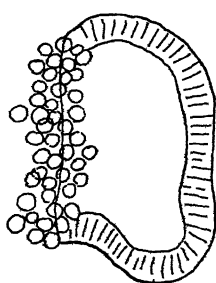


FIG. 3.—DISPERM BLASTULA. One quadrant has broken up into isolated rounded cells which leave the epithelium. The defect is closed by coalescence of the margins.

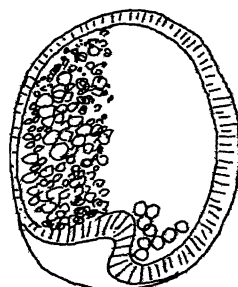


FIG. 4.—PARTIAL STEREO-GASTRULA from a disperm egg. The cells of one quadrant have migrated into the blastula cavity.

with the remainder. The defect in the body wall is closed by coalescence of the margins and the development of the diminished larva proceeds. Fig. 6 also shows this process in more detail. In fig. 4 a different aberration occurs. The cells which pass into the interior of the blastula, unlike those

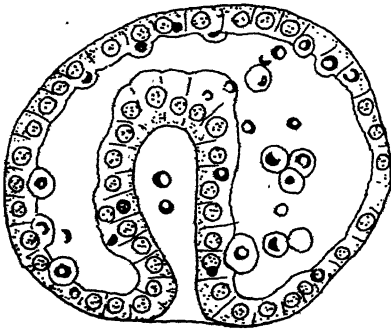


FIG. 5.—DISPERM GASTRULA with late degeneration of cells which have migrated inwards.

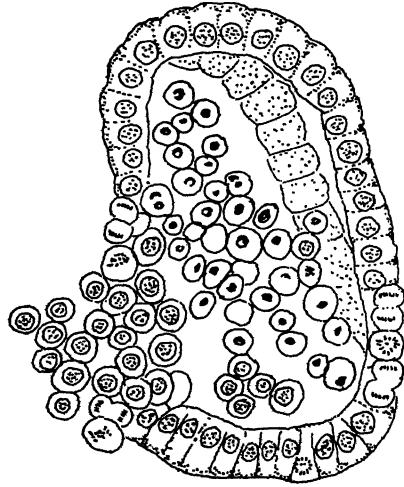


FIG. 6.—DISPERM BLASTULA with separation of the healthy dividing cells of one quadrant and degeneration of other cells which have migrated inwards.

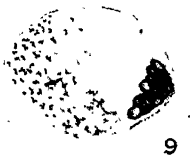
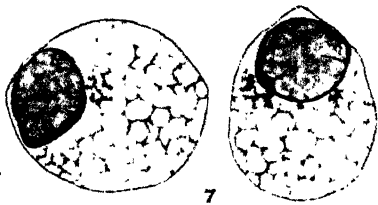
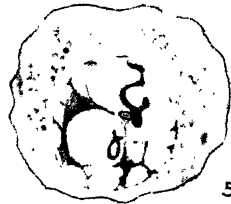
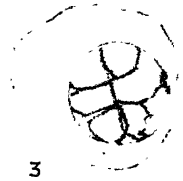
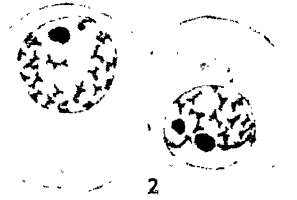
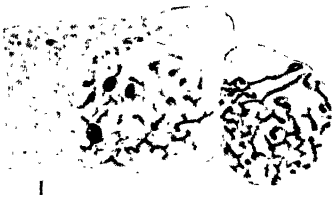
which are shed into the surrounding sea-water, quickly show degenerative changes. Their nuclei become condensed to minute highly refractile spheres, one hemisphere of which stains deeply and the other remains unstained in carmine preparations (figs. 5 and 6). Boveri devoted a chapter

EXPLANATION OF PLATE I.

All figures traced with the Camera lucida, at table level, with Zeiss Apoch. 2 mm. 1.80 N.A. Comp. Oc. 18. $\times 2000$.

Disperm fertilised eggs of *Echinus* and *Strongylocentrotus*.

- Fig. 1.*—Cell from blastula wall with adherent nucleus of a cell which has begun to leave the epithelium, showing early nuclear vacuolation and prominent nucleoli.
Fig. 2.—Cells from blastula cavity, later stage.
Fig. 3.—Double chromatin thread, similar to synaptic prophase.
Figs. 4, 5, 6.—Later stages simulating synaptic contraction figures.
Fig. 7.—Extrusion of chromatin particles: early stage.
Fig. 8.—Later stage of the same process.
Fig. 9.—Combined pathological "synapsis" and "chromidia."
Fig. 10.—Very degenerate cell from interior of blastula. Nucleus almost entirely diffused as "chromidia."
Fig. 11.—Two nuclei in hemispherical condensed final form with "chromidial" granules in cytoplasm.
Fig. 12.—Final condensed form of degenerate nucleus.



of Zellenstudien, VI, and a plate (X) to a preliminary survey and description of these nuclear degenerations, and entrusted me with their more detailed study. Pressure of other work has prevented the collection of new material of the early stages of these degenerations, so that the additions I am able to make to Boveri's account are few and of minor importance.

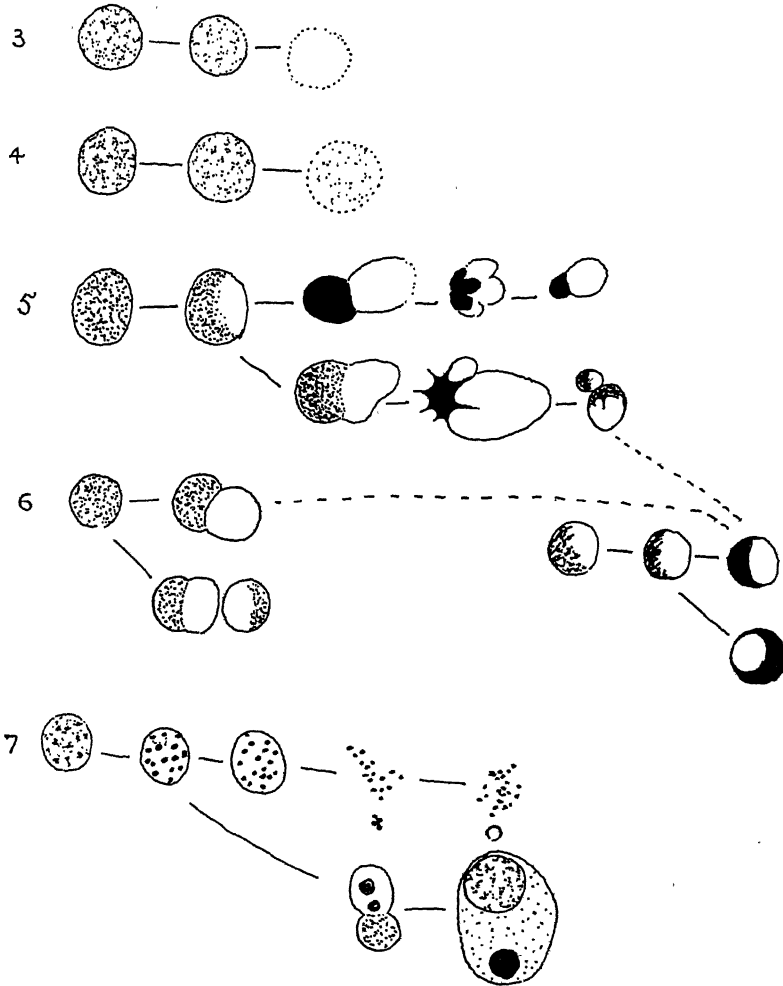


FIG. 7.—FORMS OF NUCLEAR DEGENERATION figured by Boveri. Description in Text.

I shall therefore preface my own observations with a summary, largely pictorial (fig. 7), of Boveri's descriptions.

The first form described by Boveri was that of apparently normal cells which leave the epithelial blastula wall and wander into the cavity. Their fate is unknown, and I have not included them in fig. 7. The second form

is characterized by a coarsening of the nuclear network and its apposition to the nuclear membrane. A copy of Boveri's figure is omitted of this also, as I believe these cells are the same as those shown in considerable detail in figs. 1-3, Plate I. The remaining groups in Boveri's account are shown in fig. 7 (3-7). They all, with the exception of 3 and 4, have in common a separation of chromatin and nuclear sap, and the differences are, in all probability, due to differences in degree and rate of change. Many of these go on to a final condition of extreme condensation of the chromatin into a homogeneous, hollow, hemisphere, in the concavity of which lies a highly refractile achromatic sphere. As can be seen from figs. 5 and 6, these minute intensely staining cells make a striking feature of many disperm larvæ, not the least peculiarity of their occurrence being the great variation which obtains in the time of their appearance, which may be as late as the fully developed gastrula stage (fig. 6).

The additional forms of nuclear degeneration encountered in disperm larvæ are figured on Plate I. They fall into two groups which, however, are not sharply separated, combined forms being frequent. The first group is that which includes Boveri's form (2) in which the chromatin network becomes coarser and contracted, and is applied closely to the nuclear membrane (figs. 1, 2, 3, Plate I). The figures have a general similarity to the prophases of nuclear division, the nuclear sap is clear and translucent, and the nucleolus is generally very prominent (figs. 2 and 4, Plate I). Mitosis never occurs in the cells which show these changes, and the resemblance which some of them (figs. 4-6, Plate I) present to the synaptic contraction figures characteristic of the maturation of germ cells remains unexplained. Fig. 4 shows how close this resemblance may be, and the suggestion may be hazarded, that the primary stimulus to the maturation reduction process in the normal life cycle may be some obscure metabolic disability due to a terminal failure of the normal co-operation of the chromosome system.

The second degeneration form presents a fairly close parallel to another process of nuclear readjustment, viz., the formation of chromidia, which occurs normally in some of the ciliate protozoa. Figs. 7-11, Plate I, are examples of these changes, and as will be seen the majority occur in association with chromatin contraction figures. The fact that such close resemblances to complicated cellular processes, which in normal tissues are restricted to the cells of the germinal series, can occur in the early development of pathological larvæ of Echinoderms, is worthy of note, and contains a warning for those engaged in the study of cell pathology in other fields. In the Echinoderm material we have the most weighty grounds for the conviction that the degenerative changes are the consequence of imperfect nuclear make-up brought about by multipolar mitosis. In other pathological material, especially in the higher animals, the possibility must always be reckoned with, that multipolar cell-division with consequent derangement of the chromosome groupings may have intervened at some

stage of the process. It is perhaps not without significance that the most frequent sources of nuclear degenerations which can be assigned with some

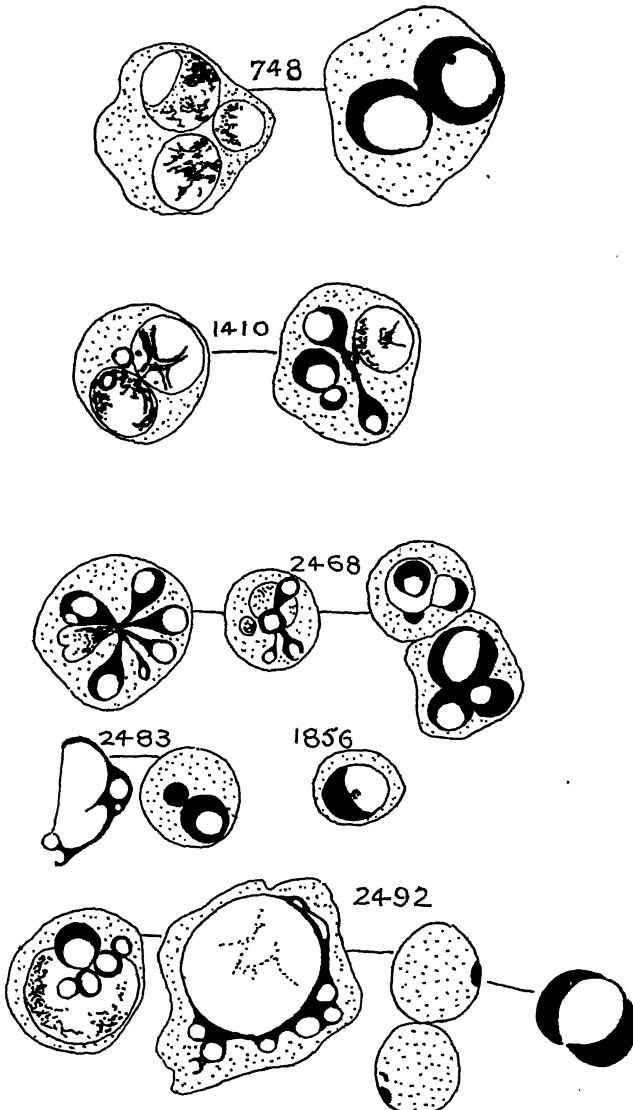


FIG. 8.—NUCLEAR DEGENERATIONS met with in hypertrophied lymph-nodes of mice. (The numbers refer to the records of tumour animals in the laboratory of the Imperial Cancer Research Fund.)

certainty to the groups described here have been met with in hypertrophic and hyperplastic conditions of the lymphatic glands. The nuclear degenerations shown in fig. 8 have all been taken from lymphomatous tumours of

mice, and the similarity of the appearances to those seen in the pathological Echinoderm material is evident. Multipolar mitotic figures are encountered with some regularity in the germinal centres of the lymph-nodes of the mouse, and the rarity of giant cells in this situation would seem to imply that it is mainly followed by simultaneous multiple cell-division. In all probability the degenerative processes are only seen in conditions of lymphatic overgrowth because in them the offspring of such multipolar figures remain *in situ*, while in normal lymph-nodes they pass without delay into the lymph stream and are distributed throughout the body.

It has seemed desirable to put these imperfect observations on record, to direct attention to forms of cell degeneration which may easily be a source of confusion and error in the analysis of pathological processes. I offer them also as an inadequate tribute to the memory of Theodor Boveri who inspired and encouraged me in the work.

II.—THE TECHNIQUE OF MOUNTING DIATOM AND OTHER TYPE SLIDES.

By PROFESSOR DON ERNESTO CABALLERO BELLIDO.

(Communicated by Dr. C. Tierney, November 17, 1926.)

FOUR PLATES AND NINETEEN TEXT-FIGURES.

INTRODUCTION.

THANKS to the kindness of our fellow-member, Mr. Frederick Adams, who undertook the translation into English, the following paper contains the more original and characteristic portions of the pamphlet describing the method discovered by Professor Don Ernesto Caballero of mounting systematically an unlimited number of diatoms, equal to the most perfect preparations of Dr. Moller, as we have been able to prove by comparison with those which have been placed at our disposal.

The pamphlet, of which we now publish an extract, appeared for the first time in full in 1897, in Spain, in the "Anales de la Sociedad Española de Historia Natural," and was translated into French in 1898, in "Le Micrographe Préparateur"; but it did not become known in Anglo-Saxon countries. A new edition, published in Madrid in 1925 by the "Junta para la Ampliación de Estudios," supported by a prologue by the eminent Dr. Cajal, recently contributed to a diffusion of the knowledge of the process in the Latin-American countries.

Though this process has been applied by the author chiefly to diatoms, it may also be applied to every class of microscopic preparation.

The description is divided into two sections: in the first, the selection and storage of diatoms will be described; and in the second, the original *modus operandi* of the author. An appendix follows these two sections, in which are given the formulae and method of preparing the substances used, and the method of making the special cells required for these preparations.

I.—SELECTION AND STORAGE OF DIATOMS.

Assuming that the worker is provided with a good collection of clean diatoms (though they may be mixed with sand or other mineral particles) stored in glass tubes in pure distilled water, to which has been added some drops of formalin to avoid the growth of cryptogams; begin by shaking the tube—for the purpose of thoroughly mixing the contents—and if the tube has been imperfectly corked, and the contents are somewhat dry, first add a fresh portion of distilled water and formalin.

Taking up with a pipette (fig. 1) a small quantity of the turbid liquid, allow a drop to fall in a small glass, or better in a small test-tube with a foot, as represented in the same figure, in which has been previously placed 3 or 4 cc. of pure distilled water. After thoroughly mixing by forcing air bubbles through with the same pipette, and filling this with liquid, deposit drops about the size of a pea upon glass slips (3 by 1 in.) that have been placed in a dish with a dark or black background. On each slip place 8 or 9 drops in the manner indicated in fig. 2, and allow them to dry spontaneously, or, if it is wished to accelerate the evaporation, it may be done by placing the slip on a hot metal plate, but the slow evaporation is preferable, as there is less probability of the very flat and delicate diatoms adhering to the glass.

The examination of the contents of each drop thus dried can be effected

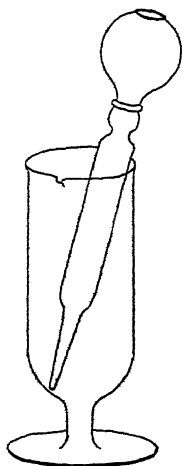


FIG. 1.

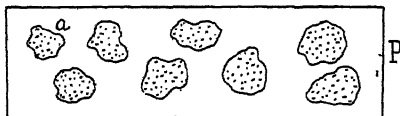


FIG. 2.

by means of a compound microscope; any small model will do if it is inclinable, and has a rack-and-pinion focussing adjustment or a fine adjustment, but it is not necessary that it should be of great precision. This instrument should be provided with a low power objective of a long working distance (12 mm.) and an eye-piece giving a large field, giving together an amplification of 60 to 80 diameters, sufficient to distinguish the various species of diatoms, though without much detail which in this case is unnecessary. The slip with the dried drops is placed on the stage of the microscope, inclining it so as to make the work easier, and illuminating the diatoms by transmitted light from the mirror, and condenser if it has one. This operation should be carried out on a solid table, cleared of all encumbrances, and of convenient height and dimensions to serve for all processes. The dimensions of the table should be 27 in. high, 5 ft. long, and 30 in. wide. The legs should be solid with a cross-bar on which to rest the feet when

working, and with two drawers in the end, but the top of the table in the centre should be completely free, and without any raised edge. It should be placed if possible in front of a window facing north, or if otherwise, provided with curtains to regulate the light, and at night work can be done by electric light, using an opaline lamp, mounted on a flexible support, such as those commonly used with an opaque conical shade, that protects the eyes of the operator from the direct light, but which directs the luminous rays over the apparatus. The chair or stool should be 21 in. high. With things so arranged, one of the drops should be brought into focus, and the slip moved on the stage of the microscope with the left hand to bring the drop into the field of view, and when a diatom is seen it can be taken up and deposited on what will be its future storage slide. Before everything the necessary articles for this part of the work must be prepared, which are as follows:—A mounted hair, a storage slide, a simple dissecting microscope.

The hair is a badger's, which from long practice has been found preferable to all those recommended by other diatomists. It is easy to obtain these hairs by cutting them from a shaving brush, and selecting under a microscope one which has a perfect point, which is not split, or has any excrescences. The point should be conical and sharp and not spherical, of adaptable

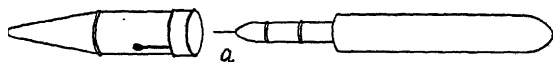


FIG. 3.

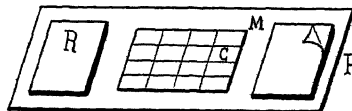


FIG. 4.

flexibility to handle microscopic objects with the same facility that small objects which can be seen by the unaided vision can be moved from one place to another by the finger. A good supply of these hairs should be made but they need not be very numerous because though the same hair serves for selection and for arrangement when the time comes, a single hair may last for years in daily use and every care should be taken to preserve one which works well. Most preparers recommend that the hair should be fixed with varnish at the end of a stick, but a fine metallic needle-holder working by pressure is preferable which has been fitted like a pencil with a protector (fig. 3). The hair should extend beyond the metal holder about 4 mm., and the metal protector will serve to cover it when not in use as it is most important that a good hair should be carefully preserved.

The storage slide, represented in perspective in fig. 4, is a glass slip (P) in the centre of which is drawn a square (C) divided into 16 or 20 smaller squares by the use of an aluminium point by which, as is well known, lines can be drawn on glass as by a pencil on paper, when the glass is perfectly clean, free from grease and moistened by the breath.

Over these squares is placed a sheet of mica (M), slightly larger, which is attached to the slide by a drop of melted paraffin and it is upon this sheet

of mica, which should be very pure and clean and through which the small squares are clearly visible, that the diatoms which it is desired to store can be accumulated. It has been found that by placing the diatoms directly on the glass slide there are certain kinds of glass which through their hygroscopic qualities, or by a spontaneous alteration of their surface, cause an adherence of the diatoms to the glass, or some are disfigured by colonies of cryptogams or by crystallization and even proper driers are not sufficient to prevent this, and it is clear that when these invasions and adherences reach the diatoms the storage plate is useless. The mica beside being non-hygroscopic carries the diatoms without the least adherence, and this is not possible on glass.

At the ends of the storage slide now being described, fix two glass squares with shellac (Appendix Note 1) about 2 mm. thick and cover with white paper. These small raised squares, as well as being used for making notes referring to the contents of the storage slide, permit, by their height above the mica, the placing of various storage slides one upon the other without fear of their crushing the diatoms which they contain, and so it is easy to store a pile of six or eight placed in a small glass case and covered with a bell-glass, preferably with a ground edge, and standing on a thick ground glass plate. This is the general means employed for the preservation not only of storage slides but of many small bottles and accessories which it is desirable to keep free from dust.

A simple dissecting microscope, provided with a doublet of 4 to 6 diameters, completes the apparatus necessary for the storage of diatoms.

The compound microscope with its glass slip containing the dried drops of diatomaceous material is placed to the left of the operator and to the right the simple microscope with the storage slide, which it is desired to fill, on its stage upon a black background. The lighting is arranged in order to see the objects in the compound microscope illuminated by refraction, and those which are placed under the simple lens by reflection, as has been described. Finding in the field of the compound microscope the diatom it is desired to store the following is the procedure :—

Taking the mounted hair in the right hand place the point in the field and touch the side of the diatom. As the greater number of species are provided with certain salients or roughnesses on their edges it is not difficult at the first contact, or after a few attempts, to attach the diatom to the hair, when it is slowly withdrawn and taken to the field of the simple microscope where it is left in one of the small squares of the storage slide by a touch with the hair on the surface of the mica.

The operation of picking up diatoms is extremely easy, notwithstanding the effect of the inverted image produced by the optical system of the compound microscope, and though the beginner in his first attempt is surprised by this inversion of the movements of his hand the habit of movement in any desired direction is very quickly acquired. Should a difficulty be found in acquiring this habit an erecting eye-piece may be substituted for the

ordinary eye-piece, such as Porro's prism or Nachet's eye-piece—but all these systems have the defect of obscuring and diminishing the field of vision which hampers examination.

In the operation of moving from one microscope to the other, the diatom is sometimes liable to fall off in transit (some 12 in.) being drawn off by the resistance of the air when the movement is made too quickly. For this reason it is better to move slowly especially when dealing with large diatoms which present a wide surface or those which from their smooth structure are but lightly attached to the hair. As regards placing the diatom in a little square, or selected place on the storage slide, there is no difficulty, because there is no inversion of the image in the simple microscope and the movements are but little exaggerated, only care must be taken not to press the hair with too much force on the mica for fear of breaking a very fragile diatom. Thanks to illumination by incident light the smallest species are very clearly visible (as brilliant points, but not resolvable), with a magnification of from 4 to 5 diameters, and are perfectly manageable with the hair when no attempt is made to place them in a pattern or fixed position but merely to put them in a sufficiently large space. Care must be taken to place the species belonging to the various large groups of the classification adopted in different small squares and even to reserve one square for rare or notable specimens. Though this is not indispensable it facilitates future operations as any given diatom can then be found in a moment.

PREPARATION OF SLIDES OF ARRANGED DIATOMS.

II.—ARRANGEMENT.

As has been explained we are trying to solve the problem of how to arrange hundreds or thousands of diatoms (the number is immaterial) on one slide, in a pattern or position previously decided, either in a series of parallel lines arranged according to classification, or forming mosaics or any sort of ornamental design, and at the same time allowing each example to be studied separately when examined with objectives of sufficiently powerful definition and magnification, or with a moderate magnification forming an artistic combination and pleasing to the eye. (See Plates II–V.)

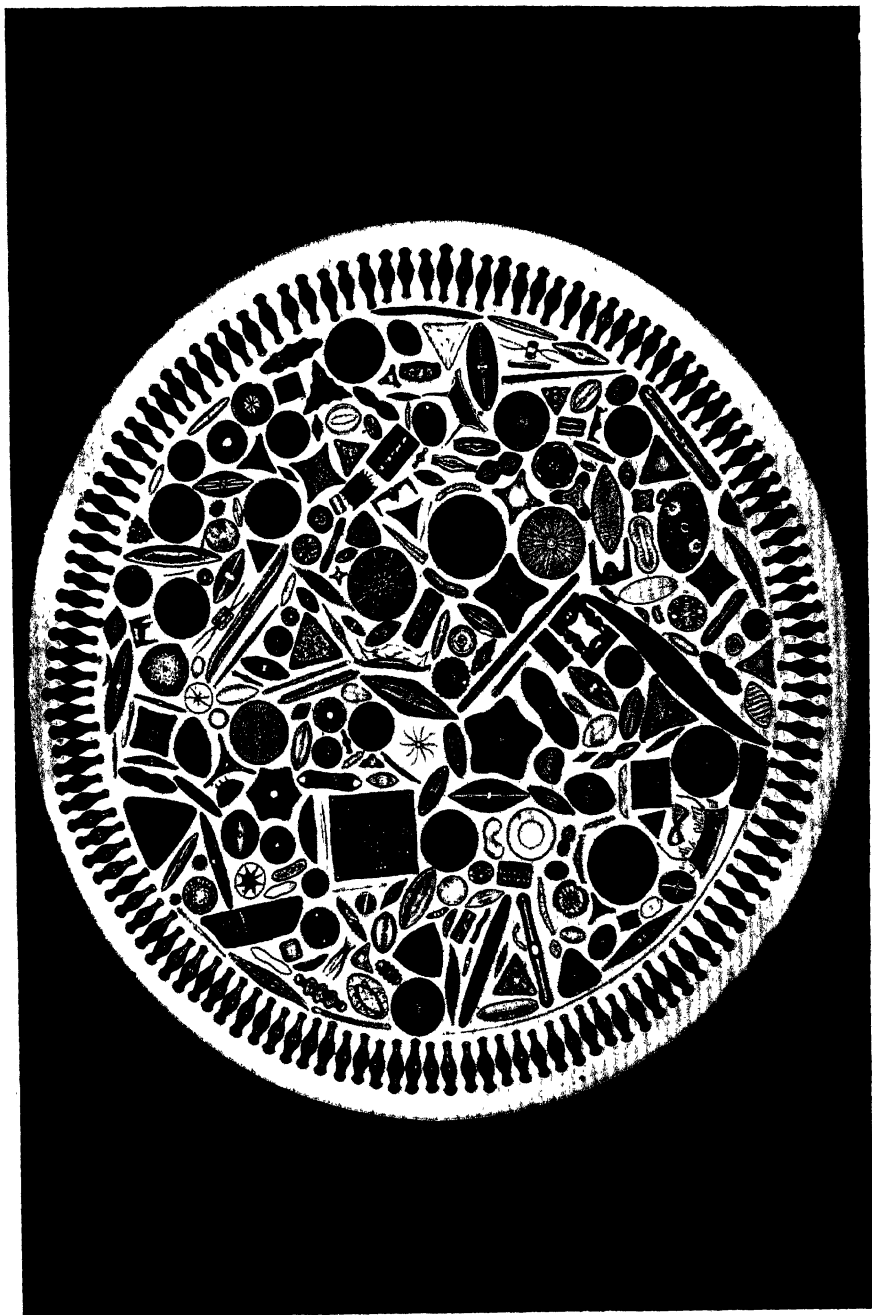
The difficulties to be overcome are many, and not the least is the moving and fixing in the required position, within the really limited space of the field of the microscope, so many microscopical objects that are measured by thousandths of a millimeter although using such small magnification: the objects must be so immovable, that, once the preparation is finished, they are proof against knocks, shaking or movement; that the cement must not be visible even with the microscope; that the work can be spread over as many days as convenient to the operator, or demanded by the nature of the work, working intermittently, at long or short intervals, the preparation is in such a condition that work may be resumed at any moment, or left for a long

time with the certainty of finding everything just as it was left and being able to continue immediately without fresh preparation. That the movement of the diatoms may be effected with such mathematical precision as to be measured by thousandths of a millimetre and with an absolute confidence that the removal or placing of a diatom close to or in contact with the others will not alter the position of those already placed ; that the operator can in the course of the work substitute one diatom already placed for another that appears to him to be better or alter in whole or in part those already arranged to make another pattern, and, finally, and this is very essential, that whilst the work may last, as we have said, for many days the small space where it is being done must be excluded from all air-currents, from the condensation of the breath of the operator, and above all, from the minute particles floating in the air and those grains of dust which would entirely spoil the delicate work.

Some of the conditions enumerated above are covered by the well-known procedure followed by many workers in making preparations of a small number of diatoms, utilizing for this a fine hair mounted on a stick with which they move the diatoms within the field of a compound microscope provided with an erecting eye-piece and converted thus into a dissecting microscope of high power, but there exists in such measures amongst other inconveniences the risk of trusting the whole result of the work to the skill of the operator more especially when working without protection (i.e. the work not covered), which in our opinion must affect the cleanliness of the preparation when the work extends for a long period, subject to frequent interruptions. We are not aware if Dr. Moller's process, which has remained secret, satisfies all these theoretical conditions presented to define the problem, but the results appear unsurpassed as much for the beauty of the preparations as for the number of diatoms used in their formation.

The method which we had the good fortune to discover consists in making clean preparations of any number of diatoms or other microscopic objects that can be dried without deformation. The work is done in an hermetically sealed chamber, protected from every exterior agent ; it permits of the work being taken up or abandoned at any moment without any greater precaution than that of covering the microscope which is done habitually to keep the instrument (but not the preparation which has been commenced) free from dust during long periods of rest ; it permits the placing of any number of diatoms, without limit, other than that of the size of the cover-glass employed (that may be up to 16 mm. in diameter) in the utilizable centre of which it is possible to place in order up to 4,000 specimens with no more difficulty than placing 1, naturally using a proportionate amount of time to the number of diatoms placed in order ; the method also permits the substitution of some diatoms for others and to destroy or re-make any part of the work before it is finally terminated. These are the characteristics of the process described as follows.

As in the chapter covering the selection and storage of the diatoms we will mention the accessories necessary for this phase of the work as they are



MOSAIC OF 489 SPECIMENS.



needed. Let us suppose that we are going to make a simple slide containing from 100 to 150 diatoms taken out of a single deposit, or a selection with the object of presenting all that may be of interest, selecting from all the species and varieties found in the deposit the individuals that represent them and arranging them in parallel lines following some classification so that the whole will present the form of a square or rectangle visible at the same time on the field of the microscope.

Begin by putting the store-slide, on which the diatoms have been placed, on the stage of the compound microscope. On the simple microscope, placed on our right hand side, put a slip with a raised square in the centre, this consists (fig. 5) of an ordinary slip (P) in the centre of which is fixed with shellac or Canada Balsam a little glass square (R) of 5 or 6 mm. square cut from a glass slip. On this small platform a small sheet of mica is placed, approximately semi-circular, some 14 or 15 mm. in diameter, which is kept



FIG. 5.

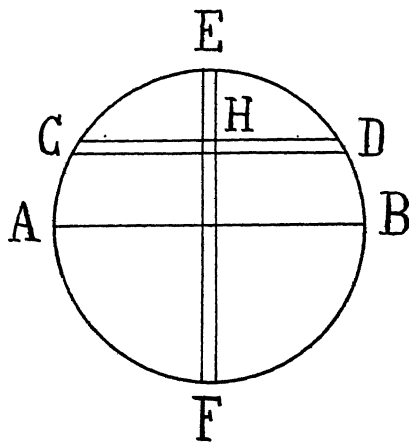


FIG. 6.

fixed to the platform by a drop of liquid vaseline so that the edges are perfectly free and can be easily grasped with fine forceps. This simple method prevents frequent accidents in the handling of small cover-glasses and as they are frequently in use it is desirable to have on hand a couple of dozen of what we may call slips with raised squares.

With things thus arranged, work in the same way as when selecting and storing diatoms, except that now diatoms already selected and conveniently grouped in the different small squares are being dealt with which very much facilitates the finding of any desired diatom to be transferred to the half-disc of mica where it can be left without worrying about its exact position but placing the diatoms in the approximate order of their future arrangement, and thus we deal with the 100 or 150 varieties of diatoms that we have assumed we should find in the deposit we are treating.

This part of the work goes very quickly and for a moderately skilful

worker, well acquainted with his store-slide, approximately at the rate of one diatom a minute. It is now necessary to have a *prepared circular glass slip*, and a *prepared cover-glass*.

The *circular glass slip* is a disc of glass 32 mm. in diameter (fig. 6), divided into two semi-circles by a diameter AB drawn with an aluminium point. In one of these semi-circles a cross is drawn formed by two systems of parallel lines, CD and EF perpendicular to themselves, so that the cross is in the centre of the radius of the semi-circle. It is in this central square thus formed that the most delicate part of the work is carried out.

The *prepared cover-glasses* are No. 0 or 1 circles of the best quality, 10 to 12 mm. in diameter, covered with a substance which remains invisible, but which fixes the diatoms after they are placed in their final position. This substance is called the *fixer*, and after trying all those recommended by others and thought of by ourselves, we consider the best to be acetic gelatine (Appendix Note 2).

The cover-glass after being perfectly cleaned first with an old handkerchief and afterwards with a sable hair brush washed in ether to remove grease (and stored in a special bottle solely for its use) is taken by the edge with a locking forceps, and with a needle fixed in a holder, which has just been dipped in a small bottle containing the fixer, pass this over the cover-glass parallel to its surface. The needle should be entirely free from grease and perfectly clean, and care must be taken when dipping it in the fixer not to let it touch the sides or neck of the bottle; and the film of gelatine which has been spread over the cover-glass must be very thin. Depositing the cover-glass, still damp, on a slide with the raised platform, to which it is fixed with a drop of liquid vaseline, it is placed at once on the stage of the compound microscope to see if there is any foreign particle in the gelatine, which is still liquid (its fluidity may be maintained by breathing on it) in which case the particle must be drawn to the border by a thick hair mounted on a stick. If through neglect of some precaution there are many impurities it is better to throw it away. The prepared cover-glass, with its slip and raised platform, is now placed in a small glass case which is covered with a bell-glass to be absolutely protected from dust (the edges being ground, and even waxed with paraffin wax, on a ground glass plate) where 20 or 30 cover-glasses prepared in the same way at one time may be placed. The prepared cover-glasses, once dry, may be preserved indefinitely with all their adhesive power, and the best thing is to keep them, with the gelatine surface downwards, in a copper wire frame which will hold 20 or 30 and may be covered with a bell-glass as described and within which can be placed a beaker glass with sulphuric acid to maintain its dryness.

With all these things thus arranged, take the circular slip (fig. 7), and fix the small mica slip (S) containing the diatoms from which the slides are to be made, on the lower semi-circle, with a drop of liquid vaseline, and in the upper semi-circle one of the prepared cover-glasses (C), quite dry, and with the gelatine upwards, centring it as accurately as possible, an operation

which is facilitated by the lines drawn by the aluminium point, and a few concentric circles, which are not difficult to make with a diamond. The details, however, of this not indispensable operation would lengthen this already too minute description too much.

This support has now to be installed in a kind of hermetically sealed chamber within which the hair that will carry the diatoms from (S) to (C), will move and will put them microscopically in the place and position desired. For this it is necessary to prepare a special microscope devoted exclusively to this work. It must be a compound microscope, either a large or small model with a large fixed stage that does not revolve, and with a sliding draw-tube to allow any desired adjustment between the eye-piece and the objective ; and for focussing, a rackwork coarse-adjustment and a slow fine-adjustment.

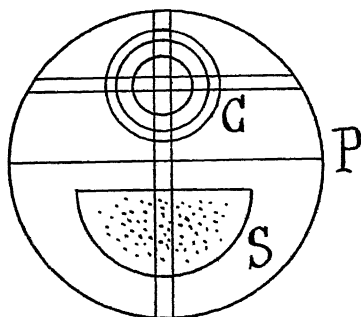


FIG. 7.

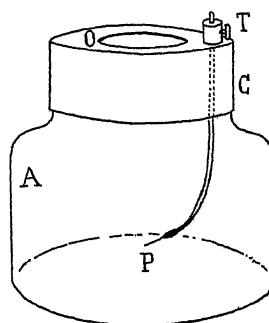


FIG. 8.

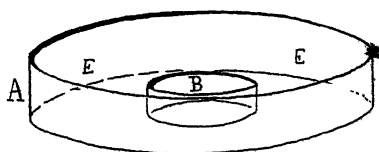


FIG. 9.

Any system of illumination can be used, but preferably that of a sub-stage condenser. It is not necessary for the microscope to be inclinable, as it will always be used in a vertical position, nor is it necessary for it to have any other fitting, and the stage should be cleared of anything that may be on it. The optical combination used should be a low power objective of 10 to 12 mm. working distance, and eye-pieces changeable at will, to obtain a magnification of 50 to 60 diameters.

The fittings which are to be fixed to this microscope once for all for our special purpose are :—

A cylindrical cap of sheet brass (C) (fig 8) that has upon the upper edge a perforated block or button of the same metal, and a copper wire passing through the hole which is fixed in a convenient position by a clamping screw (T). At the end of this wire which has been sharpened to a flat point,

is fastened with shellac, a good hair (P) allowing it to extend 3 or 4 mm. beyond the end of the wire. In this cap is fitted a kind of bell-glass (A) held in position by friction, like a wide mouthed bottle without a bottom (the one we always use was cut from the upper part of a bottle). The upper part of the brass cap has a circular hole in the centre (O) for the purpose of being fixed, as we shall immediately see, to the nose-piece of the microscope, which has a female thread, the thread of the objective screwing into it, with the brass cap acting as a washer between the two. In addition to this fitment a system of concentric circular glass dishes is provided (fig. 9), consisting of Petri dish (A) in the centre of which is fixed, with balsam, a smaller one (B) not quite so high (a small crystallizer) and of a diameter equal to one-third of that of the larger dish (some 30 mm.) about the size of the circular slip already described.

The bottom of the larger glass dish, on the outside, is covered with a piece of flannel, which has a circular opening in the centre rather larger than the smaller dish (B).

Returning to the microscope fasten to it, as before described, the metal cap, without the small bell-glass, introducing the thread of the objective by the orifice (O) (fig. 8) and screwing the objective into the nose-piece which thus clamps and holds the upper plate of the brass cap fixing it in place once for all as though it formed part of the microscope. The position of the hair now has to be definitely fixed, for which purpose the field of the microscope is illuminated and pulling out the draw-tube half its distance the image of the hair must be got within the field, a result which is obtained by raising, lowering, and bending the wire that intentionally has not yet been fixed, leaving the clamping screw (T) still loose. When the point of the hair can be seen clearly in the centre of the field the clamping screw (T) is tightened to ensure the immovability of the hair. The operation of fixing the hair in the right position is tedious, but, thanks to the flexibility of the wire and if the precaution has been taken beforehand of observing some other object, with the tube half drawn out, to ascertain the working distance of the objective, the hair can be immediately placed at approximately the right distance and in the centre of the field not yet having placed the small bell glass in position which very much facilitates the work of finally perfecting the position after the glass is in place. On the other hand it will not have to be repeated often, because a good hair well fixed may serve for years of daily work without any necessity for renewal.

The length of wire above the clamping screw should be cut off flush, and the opening filled in with a little paraffin wax. Finally, the image of the hair should appear as coming out from the left-hand side of the field (to obtain which it is sufficient to rotate the brass cap before tightening it up), and with an inclination of some 45 degrees above the horizontal plane. The point is seen as though it were in the air, but it will remain fixed, and in focus, so long as the tube-length is not varied. This being done, the microscope placed in a vertical position, and the worker seated in a chair



of convenient height for him to dominate the work with the least effort, all the movable system is raised with a rapid upward movement of the coarse adjustment, the bell-glass is slipped into the brass cap and the Petri dish placed on the stage, the circular slip with the cover-glass and mica disc adhering to it having been previously placed simply resting on the edges of the small inside dish. Fig. 10 represents the microscope provided with this installation.

Using a toothpick, or a strip of wood with a fine point, attached by a

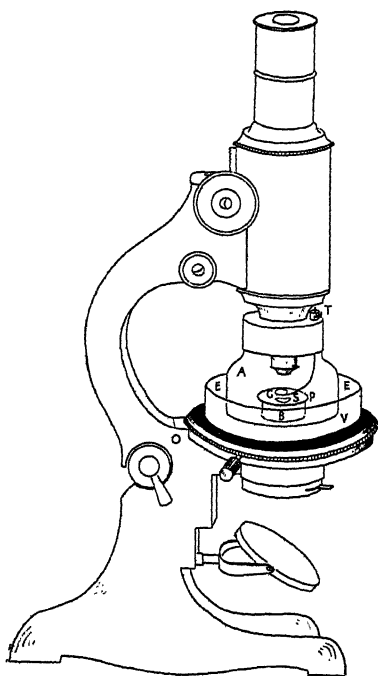


FIG. 10.

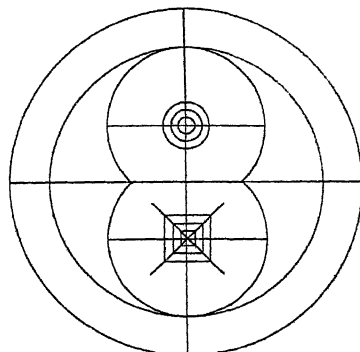


FIG. 11.

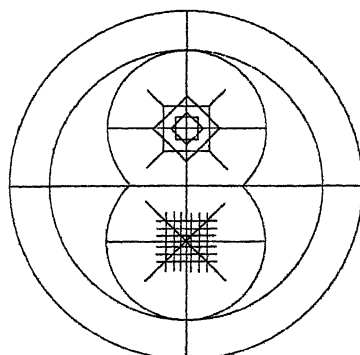


FIG. 12.

spiral wire to the cork or cover of a small bottle (to avoid too heavy a pressure when applying the point of the toothpick), place a drop of fluid mono-bromide of naphthaline near the edge and on the right hand side of the prepared cover-glass.

This mono-bromide of naphthaline, as well as nearly all the liquids fixed and volatile that will be used in the work, should be kept in bottles of 5 to 10 grammes, covered with glass caps ground to fit, suspending in the interior the glass rod, or pipette which is used. The advantage of the glass hood over the ground stopper is that there is less probability of its sticking and it is less likely to allow dust to enter. Having placed the drop, the space **EE**

of fig. 10 is filled with mercury between the two concentric glass dishes, up to within 8 mm. of the top. The body-tube of the microscope is then lowered by means of the coarse-adjustment so that the bell-glass (A) enters the mercury, thus producing the perfect lock necessary, without impeding the vertical and lateral movements that, within certain limits, have to be initiated with the two principal parts of the equipment—the body-tube with its hair and bell-glass, and the glass dish (V) on the stage.

The question is now reduced to the operation of manipulating the hair from the outside, compelling it to take up the diatoms, moving them from (S) to (C) (fig. 7) without opening the chamber, and placing them as desired. Everything is now arranged in such a way that the hair is visible in the field of the microscope when the draw-tube is half extended, but if the tube is now pushed in as far as it will go, the distance between the eye-piece and the objective is diminished and the focal plane of the optical combination moves further away, the hair being no longer visible or only as a shadow. With the focal distance thus lengthened we have a margin within which to look for the plane of the slips without any danger of the hair touching them as it is now well above them, and guided by the lines marked by the aluminium point, and initiating, with the left hand, horizontal movements of the glass dish (that moves very easily on the stage, thanks to the flannel lining on the bottom), and at the same time focussing the microscope with the right hand, the sheet of mica (S) is very soon found and on it the first diatom which it is proposed to move. When this is found the draw-tube is again drawn out until the hair is in focus, but now the diatom is farther away and out of focus, but again focussing the microscope, without altering the tube length, the point of the hair and the diatom are got into the same focal plane (that is, the surface of the mica), and by a horizontal movement of the glass dish, always moving it with the left hand, and the simultaneous vertical movement of the body-tube or coarse-adjustment of the microscope, always managed with the right hand, the diatom can be taken up with the hair, from which it remains suspended, whilst the glass dish is moved until the little square that marks the centre of the cover-glass (C) is seen somewhat out of focus, the coarse-adjustment is then lowered, and the diatom is placed on the cover-glass. To facilitate this last movement, and because it is necessary for others in the future, a microscopic drop of mono-bromide of naphthaline is previously placed near the centre of the cover-glass (C), taken from the drop that was deposited on its edge before closing the chamber, it being enough for this purpose to dip the hair in the large drop laterally, and draw the small portion required by moving the glass dish horizontally. It is in this drop, placed near the centre, where the diatoms already moved are placed as in a bath, and where ten, twelve or twenty more can be placed, repeating the operation necessary to place the first. All this is much more difficult to explain than to practise, and much more quickly done than described, and an operator of very little experience can move 3 or 4 diatoms a minute, always supposing that the relative order in which they have been already

placed on the sheet of mica, does not require many attempts. When a certain number of diatoms are immersed in the liquid they are removed one by one to the definite position they are to occupy in the finished slide, a perfectly easy operation thanks to the smooth and easy movement of the glass dish without jerks or oscillations which are absorbed in the inertia of the glass dish full of mercury; to the fixed position of the hair in the vertical plane that also cannot move except voluntarily, and by thousandths of a millimetre, and that also effects a pushing movement as slight as desired to which the docile flexibility of the hair lends itself, that bends and moves forward the smallest amount when it is moved downwards by means of the fine adjustment of the microscope, the glass dish remaining steady; and finally to the fact that the diatom is not drawn across the microscopically rough surface of the gelatine smooth as it may appear, but rolls over the enveloping liquid that serves as an ideal lubricant, the placing of a diatom in situ in any position from the time you commence to push it is only a matter of a few seconds. We say *push* because it is thus the hair should always operate, as a finger pushes a small object on an oiled plate, and this is achieved by causing the glass dish to revolve on its horizontal plane until the hair seems always to push the diatom upon which it is working. It must be remembered that in reality in our method of work it is the hair which is fixed and the diatom that moves, contrary to all known systems; but the final result is the same, and much safer and surer.

For the final operations, however delicate they may be, a rough movement of the hair can never (except through some carelessness) destroy any part of the work in progress, and it is possible to place all the diatoms that will constitute the finished slide in order without taking the precaution, more prejudicial than useful in our case, of fixing them one by one as was formerly done, and this although the preparation may consist of thousands of diatoms. When the diatoms are lubricated (but without excess) with the mono-bromide of naphthaline it is possible to turn them over by placing the hair beneath them and arrange them so as to present their convex or concave side, flat or on edge, and even to double over or curve the long and flexible species—in a word, to do with them what we will. It is also possible now to remove from a diatom any grain or particle of dirt that may have adhered to it. Within a short time of placing the diatom in its position the mono-bromide will evaporate. If the diatoms are to constitute a finished slide in a definite order, as we presume is being done, they should be arranged from right to left in the field of the microscope, because the cover-glass is inverted on sealing the preparation, and in this way the new inversion that will be produced in the finished slide is compensated. We should also proceed in the same way when making monograms or inscriptions, namely from right to left as in a lithographic stone.

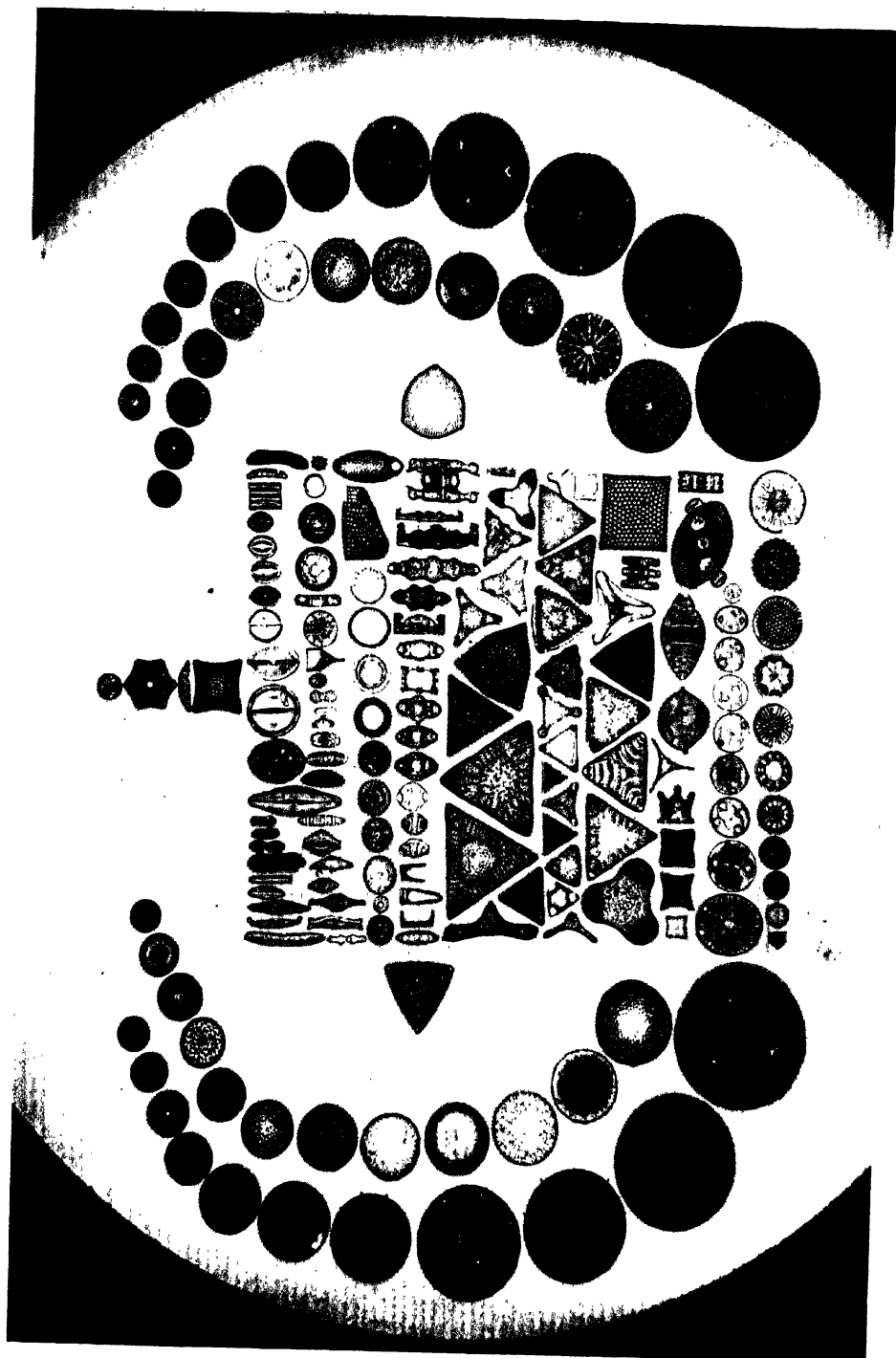
The use of a liquid to facilitate a smooth movement without jumping is one of the characteristics and essential basis of our procedure, together with working in a sealed chamber, and the utilization of changes of focus produced

by the variation of the tube-length of the microscope, and also fixing the hair to the objective and moving not the hair, but the carrier which contains the diatoms.

This last result we obtained in the early years of our practice by using a mechanical stage, and it thus appeared in the paper published by me twenty-six years ago, but experience has proved that the safest, most rapid, and precise method is the movement by hand of a glass dish on the fixed stage. The reserve of mono-bromide placed at the commencement of our work at the edge of the cover-glass may only be enough for one day's work because of the amount taken for each diatom, and also loss by evaporation, but if the work is to last for many days it is enough at the beginning of each day's work to raise by means of the coarse-adjustment the body-tube with the bell-glass sufficiently to move the glass dish aside, so that the prepared cover-glass may be outside the edge of the bell-glass, when a new drop may be placed on it repeating this operation as often as may be necessary.

Placing 100 or 150 diatoms in this way is a matter of 3 or 4 hours, or two per minute after the chamber is closed, and knowing the exact place and position in which they are to go, either because a similar slide of the same number has already been made, or one is being copied; but the time is lengthened if one goes on inventing or having ideas for new arrangements with selected diatoms, that approximately, but not more than approximately, follow a sketch or outline that should *precede* all work when it is not a copy, or repetition of a previous one, and many times even an approximate sketch is not possible, as in the case of mosaics and of diatoms in ordered lines or groups of a large number of forms that can only be seen to be properly placed in the mosaics afterwards or occupy a convenient space in the lines, and hence the advantage that part of the work may be cleared away and re-made which can only be done when the diatoms remain without fixing till the last moment as is possible by our method.

Having finished the arrangement of the diatoms in the position desired, the whole surface of the cover-glass is reviewed, with the draw-tube pushed in, to ascertain if any diatom has got out of place, or been forgotten, or a particle of dirt has got in, which can easily be knocked off by the hair beyond the edge of the cover-glass, the operation of fixing is immediately begun. This consists in re-softening the extremely thin film of gelatine, so that the diatoms adhere to it. This is attained by raising the body-tube with its bell-glass and moving the glass dish a little aside without removing it from the stage and breathing very softly on the cover-glass, without blowing, and returning it immediately to its former position with the chamber closed. After two or three minutes the prepared cover-glass is examined and some of the diatoms which, owing to their shape have got fewer points of contact with the gelatine, are touched with the hair, and if it bends without moving them we can consider that all the diatoms are properly fixed, but if any move we must repeat the operation of softening though it is not wise to insist very much upon doing this nor to prolong the moistening, because then the gelatine will be visible under the microscope. With a fixer properly



prepared, and with the cover-glass in proper condition, a single moistening should be sufficient to leave the most refractory diatoms properly fixed. From this moment the operation of mounting, to be explained in the following chapter, is proceeded with. If in place of a simple mount of a small group of diatoms placed in order, like that which we have just taken as an example, it is desired to place them in the form of a star, circle, mosaic, rosette, or any other ornamental form, the process is exactly the same, only the glass dish will have to be turned round very often so that the hair works always pushing, and even thus the stars, crosses, and general geometrical designs are easier and more agreeable to make than those forming lines; but as it is not all workers who have the ability to make a symmetrical design, or even straight parallel lines without a guide, lines may also be used to attain this object which greatly facilitate the work, and these can be made by drawing a large circle on any scale, divided into squares, and in the centre of the radius of the two opposite semi-circles, concentric circles, squares, rectangles, stars, etc. A photograph of this drawing is taken, reduced to the size of a cover-glass and reproduced as a positive on glass, fixed, hardened by chrome alum, and with the disc cut out, presents the form of figs. 11 and 12, and is employed as a support instead of the simple circular glass slip with aluminium lines, that is, nevertheless, in the majority of cases, the only one we ourselves use as cleaner and more transparent than those covered with an emulsion the grain of which is visible under the microscope. Perhaps a collodion photograph, that we have not tried, might be found free from this defect.

CLOSING AND FINISHING THE SLIDES.

The diatoms being fixed in their definite position on the centre of the cover-glass, it is necessary to mount this in a manageable and permanent way, either dry, or with the diatoms submerged in a clear medium. The visibility of a transparent object depends as is well known upon the difference between its own refractive index and that of the medium in which it is submerged, and as diatoms are of silica they stand out well enough if they are mounted dry within a cell prepared in the manner described. (Appendix, Note 4.) A slide prepared in this way is said to be a "dry mount." Our process with the cover spread with gelatine allows a very perfect presentment as the gelatine is almost invisible even in the medium of air, but if it is desirable that they should be absolutely free from all fixer then our methods, and perhaps those of Moller, are the only ones that allow this achievement, for it is sufficient to mount them, following the given rules, upon an absolutely clean cover-glass and when they are finished to put the cover-glass on a slip of very thin sheet iron (L.), fig. 13, and heat it till it is a dark red, to which cover-glass the diatoms adhere very well (especially those that are flat and very thin as are the greater number of those used as "test objects" by microscopists, the only people who require dry mounts for very special study), without using

any fixer to mount them, and they may be handled without fear of their coming off.

But the dry mounts, with or without a fixer, should be reserved exclusively for preparations for special study because the reflections and refractions of the light and the numerous planes and complicated structure of the silicious valves causes a confused appearance very different from the brilliant appearance they present when mounted in a medium of superior index to that of silica and which prevents the production of those optical phenomena that are so troublesome.

Among the substances of an index superior to that of silica, Canada balsam, styrax, and mono-bromide of naphthaline are almost exclusively used for mounting diatoms, but some others that have been suggested are difficult to use and easily deteriorate. In practice they are reduced nowadays

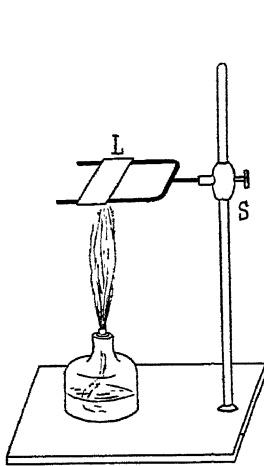


FIG. 13.

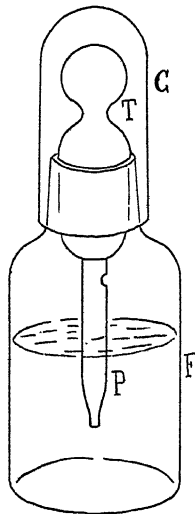


FIG. 14.

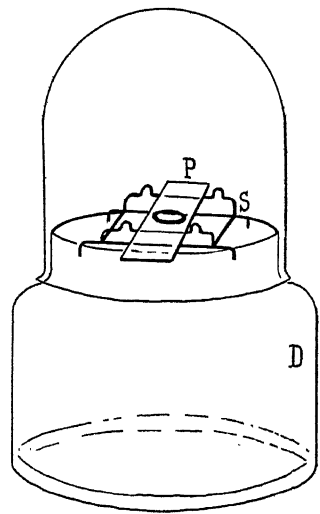
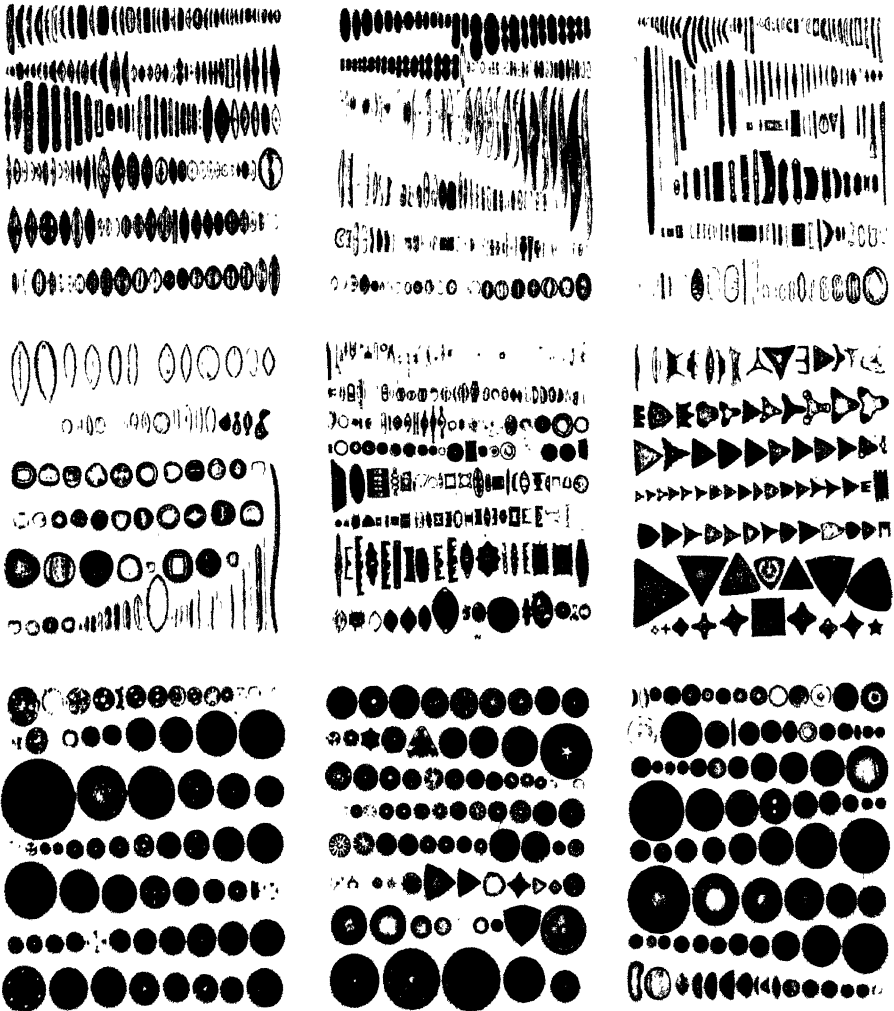


FIG. 15.

to two—styrax, and mono-bromide of naphthaline, and in a special case and only for test objects, realgar. So far as balsam is concerned, which was the first substance used, it is no longer employed by any worker in diatoms owing to its low co-efficient of visibility. We shall give details of the method of working with mono-bromide of naphthaline stating that we give exclusive preference to this medium, for if its excellent qualities were indicted by Dr. Moller who introduced it into diatom technique, complaining of the *inconvenience* of its alteration in many cases, we believe that we have discovered how to eliminate all the possible causes of change in this medium, and a proof of it is that we have in our collection slides made twenty-seven years ago that are in the same perfect condition now as the day they were made. For this reason we only use this medium at the present time, and because from its index of refraction it gives a co-efficient of visibility much



SYSTEMATIC PREPARATION. 1142 SPECIMENS.

superior to that of styrax, as well as being absolutely without colour, which gives the slides an aspect of cleanliness, transparency, and brilliancy that leaves nothing to be desired.

To work with mono-bromide of naphthaline (fixed), a medium that should be kept in a glass-capped bottle with a pipette, as represented in fig. 14, we proceed in the following manner. The cover-glass with the preparation now finished that was in the sealed chamber is taken from its circular support with fine forceps and placed on one of the slides with a raised glass square and put in the drier (D) with sulphuric acid, as in fig. 15, where it is placed on the wire bridge (S) and left for some hours (one night) to ensure its complete drying. Taking the slide from the drier, the cover-glass is lifted with a special forceps (P), fig. 16, provided with a clamping screw (A) with a

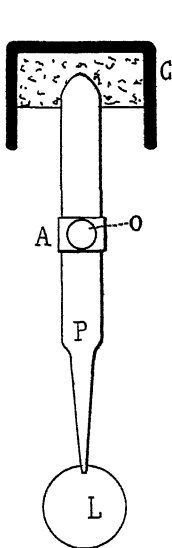


FIG. 16.

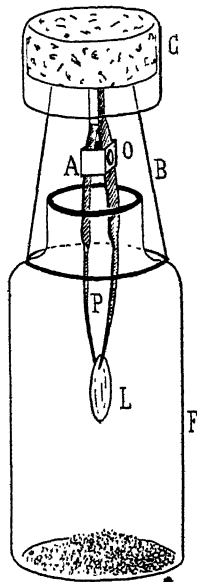


FIG. 17.

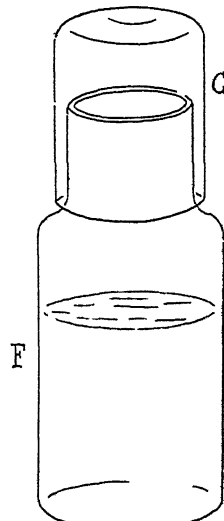


FIG. 18.

button or indicator (O), and fixed in a cork slab pushed into a glass cap (C). The object of this arrangement is to indicate at any moment by means of the sign O, which is the side of the cover-glass upon which the diatoms are mounted, and care must be taken to secure this in taking up the cover-glass from the slide, so that the cover-glass may be suspended in the centre of a wide-mouthed bottle (F), fig. 17, the neck of which is lengthened by means of a glass cone (B), and in the bottom of the bottle are placed drying substances or absorbents of certain vapours (as may be seen in fig. 17), or liquids, as shown in fig. 18, which is the same as fig. 17, only closed with a cap which replaces the equipment of forceps, cone, and cover-glass when the right moment arrives. Of these bottles we must have at least five, three with petrol, one with benzine, and one with absolute alcohol.

The cover-glass taken as aforesaid with the forceps, and suspended in bottle No. 1, containing petrol, for five minutes, is passed afterwards to No. 2 for two minutes, and finally to No. 3 for one minute. The object of these immersions is to clean the cover-glasses and diatoms scrupulously as much on one side as the other, and to eliminate every trace of vaseline that was used to fix it provisionally to the different supports that we have used, and the rest of any grease or particle that may have remained by accident. Immediately afterwards, if the preparation is to be mounted dry, it is passed to the bottle (F), fig. 17, in the bottom of which has been placed shavings of paraffin wax, which absorb the petrol vapours until it is completely dry, when it is mounted on a cell in the same way as we shall explain on treating the preparation in the medium of mono-bromide.

To work with this medium, the only one we recommend, we commence by placing flat on the table a perfectly clean dry glass slip with a cell (Appendix, Note 4), and the cell is completely filled with mono-bromide, fixed (Appendix, Note 3), taken up with the pipette P from the bottle (fig. 14), and immediately lowering on to the cell the cover-glass with the diatoms on the lower side that we have in the clamped forceps (P), fig. 16, still damp with the petrol, as it left the third washing bottle. The two liquids, the petrol and the mono-bromide, mix instantly without ever producing bubbles. There remains an excess of liquid flowing over from the edges of the cell, and now the cover-glass is carefully centred and aligned, using a lens and a wooden toothpick, and is immediately covered with a small bell-glass leaving it for 24 hours in which time the petrol, being more volatile, evaporates completely as well as part of the surplus mono-bromide. There remains some mono-bromide still outside of the cell which is absorbed with a strip of blotting paper. With a very fine needle the edge of the cover-glass is carefully pushed to be sure of its adhesion to the cell, an adhesion which should be perfect and spontaneous, as through the evaporation of part of the interior liquid the outside atmospheric pressure causes an automatic seal which cannot be obtained by any other means. The slide is then cleaned and the sealing of the cell is protected by a first ring of normal shellac (Appendix, Note 1), put on with a turn-table, and then left to dry spontaneously. To improve the appearance, and to hide the edges of the cover-glass, some other coloured rings may be applied, and the slide finished by fixing labels on the ends, giving the number of the slide, the locality of the diatoms, and any other details which may be considered necessary.

APPENDICES.

Note 1. Normal Shellac Varnish and Coloured Varnishes.—Place in a covered glass bottle any quantity of commercial red shellac in scales, and cover it with 98 p.c. alcohol, shaking it from time to time to dissolve it. After remaining some days, decant the upper clear part, which is caramel colour, very dark, and of the consistency of a thick syrup. This clear varnish

may be kept indefinitely in another corked bottle, from which is taken the necessary quantity for daily use in a third bottle of some 10 grms., with a glass cap ground on. The opaque coloured varnishes are obtained by mixing normal shellac with inert powdered colours, ground exceedingly fine (vermilion, chrome yellow, prussian blue, etc.), the mixing being made in a small porcelain mortar, and kept in bottles with glass caps ground on, and at the time of using it will be necessary to stir the mixture well with a glass rod for some minutes until it has become completely homogeneous. These opaque-coloured varnishes are used for giving the last rings to a cell when finishing off a slide.

Note 2. Acetic Gelatine.—Place $1\frac{1}{2}$ grms. of gelatine of best quality in a small glass flask and cover with 12 cc. of distilled water. When the gelatine has softened its colloidal dissolution is hastened by heating in a water bath of a temperature of 90° C. When completely dissolved add $12\frac{1}{2}$ grms. of acetic acid (crystallizable) and 2 grms. of absolute alcohol. The flask is then corked and placed again in the hot water, shaking it from time to time, and finally filtering it hot through a filter paper. It is better to repeat the filtration three or four times, receiving the filtrate in a bottle with a glass cap ground on in which it should be left for three or four days before using. If after some time any deposit is seen at the bottom, it should be again filtered into a dry and clear bottle.

Note 3. Purifying the Mono-bromide of Naphthaline.—By a long series of observations we have discovered that frequently the defects in slides mounted in mono-bromide of naphthaline were due to the mono-bromide used, and so to-day we subject all the mono-bromide from wherever it comes, to a fractional distillation, separating the fluid that distils at a temperature below 270° C. (and this we call fluid mono-bromide) and collecting and filtering through pure animal charcoal that which distils at 270° C., that we call fixed mono-bromide, and is solely that which we use as a mounting medium, reserving the fluid for the lubricating of the film or fixing gelatine, and the transport of diatoms in accordance with the details given previously.

Note 4. Preparation of the Cells.—We take glass slips of English size 3 in. by 1 in. and best quality, and use the ordinary turn-table provided with a fixed square that permits centring the slips. Moistening a fine brush with a metallic holder, in normal shellac varnish, and giving a twist to the turn-table put the brush to the glass, and make a ring proportionate to the size of the cover-glasses used (we use only those of 10 to 12 mm. in diameter), 2 to 3 mm. wide, and of the thickness that the shellac will stand without running. In the same way, 20 or 30 cells are prepared at the same sitting and they are left to dry spontaneously, protected from the dust. If the first ring is not of sufficient thickness to protect the largest diatom from being crushed, on the first ring after it is quite dry a second or even a third is necessary. When the cells are quite dry, we proceed to heat the shellac, without which precaution it would quickly be attacked by the mono-bromide. This is done by placing the glass slip on a hot copper plate, similar to that

represented by fig. 19. In moving the slips along from the coldest to the hottest part the operation until the first slide reaches the end of the copper plate should take about 20 to 30 minutes. It is desirable to have the lamp wick very low so as not to heat them too rapidly. The successive slip can be taken away much more quickly (after five to eight minutes on the end of the copper plate), because they are occupying each time a hotter part of the

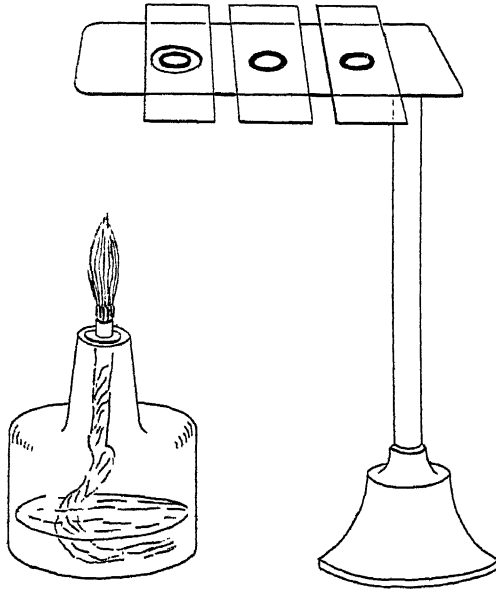


FIG. 19.

plate. Finally we have to plane off the top of the cells so that the cover-glasses with the diatoms may be adjusted without rocking; this is done by rubbing them down on an emery stone, and it is well to paste paper on the other part of the slide to avoid it getting scratched with loose emery from the stone. The cell once finished should have a perfectly smooth mat surface when examined by a lens, and of a hardness that cannot be scratched by a finger-nail.

III.—THE LIFE-HISTORY OF THE NEUTROPHIL POLYMORPHONUCLEAR LEUCOCYTE.

By W. E. COOKE, M.D., F.R.C.P.E., M.R.C.P. (Lond.),
D.P.H. (Lond.), F.R.M.S.,
Director of the Pathological Department, Wigan Infirmary,
Hon. Consulting Physician, Leigh Infirmary.

(Read February 16, 1927.)

THREE PLATES AND FOUR TEXT-FIGURES.

THE GENESIS OF THE NEUTROPHIL POLYMORPH.

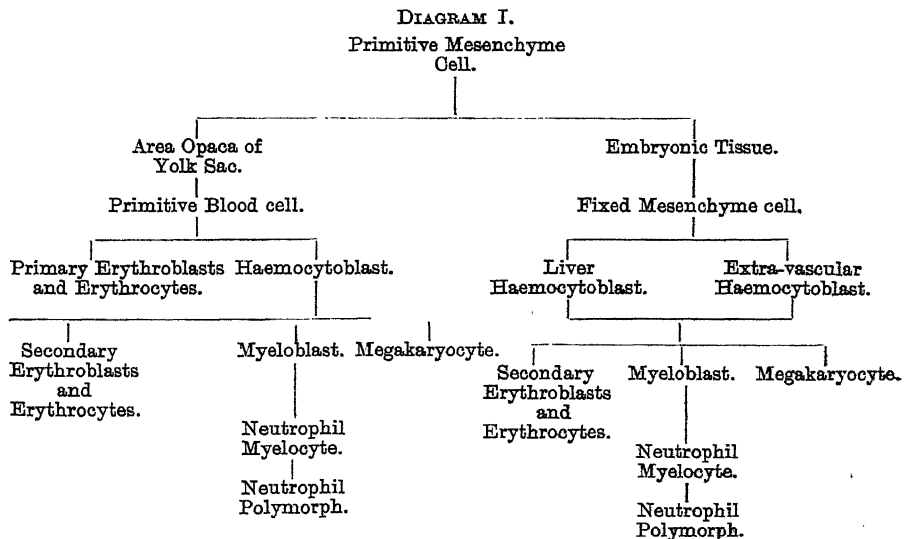
THE true neutrophil polymorph is quite a recent cell in the vertebrate scale. It is not seen in amphibia, fishes, reptiles, nor in any cold-blooded vertebrate. Only when we come to the birds is the homologue of the human neutrophil polymorph found.

The embryology may be briefly stated. The primitive mesenchyme cells in the area opaca of the yolk sac multiply, the peripheral cells become differentiated to form the endothelium of the vessels and the plasma, and the central cells form the primitive blood cells. These blood islands are, of course, extra-embryonic.

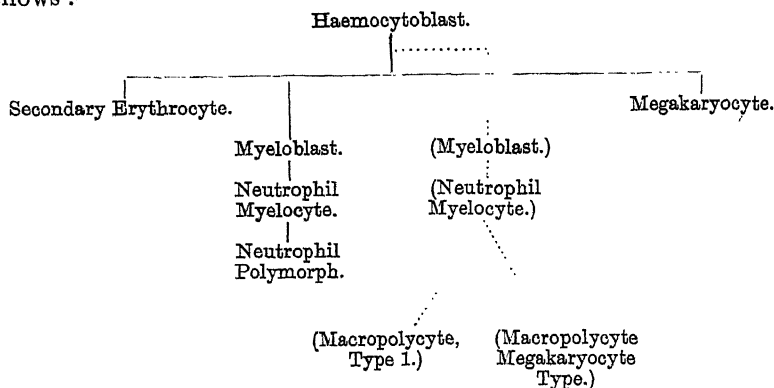
At the same time the embryonic mesenchyme is being differentiated into endothelium and plasma, but the blood vessels and heart contain very few, if any, primitive blood cells.

By the third week communication has been established between the extra-embryonic vessels and the vessels of the embryo, and the first blood cells of the embryo arise from invasion by the cells of the blood islands of the yolk sac.

Diagrammatically, the foetal origin of the neutrophil polymorph could be represented as follows:—



The post-natal origin of the neutrophil polymorph may be represented as follows :—



The reason for bringing this short scheme before your notice now, is that it is necessary at the outset to remember that the potentiality of the daughter cells of the hæmocyctoblast under ordinary conditions is definite, and when differentiation has reached the myeloblast stage it is irreversible, development going on to the normal granulocyte of the blood stream. The dotted lines may be left out of consideration for the time being.

THE LIFE-HISTORY OF THE POLYMORPH IN THE BLOOD STREAM.

The polymorph has a varying number of nuclear segments. The percentage of cells, in health, having 1, 2, 3, 4, or 5 segments may be taken as :—

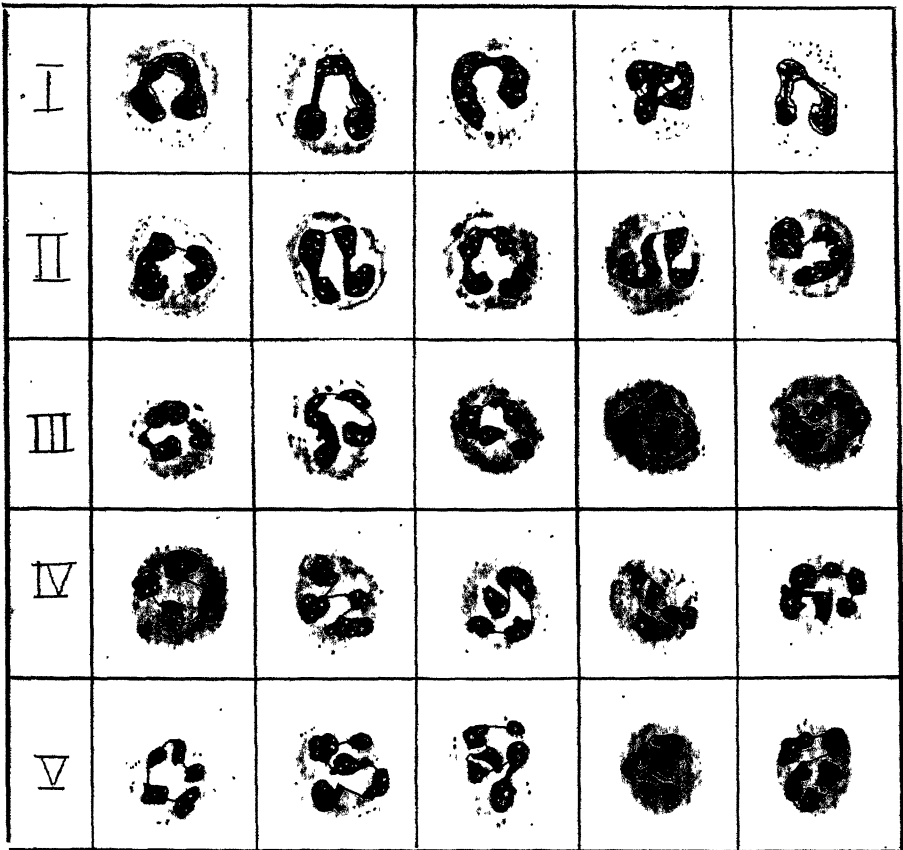
I	II	III	IV	V
10	25	47	16	2

PLATE VI.

The cells with 1 and 2 lobes are younger than the 3, 4, and 5 classes, and the constant proportions in health may be taken as representing the state of equilibrium between the rate of production by the marrow and loss by death.

In infective states the numbers in classes I and II are increased, and the count has a left-handed appearance, as in the following examples :—

	I	II	III	IV	V
Typhoid fever	54	31	15	—	—
Scarlet fever	44	43	13	—	—
Measles	45	39	16	—	—
Erysipelas	45	40	14	1	—
Diphtheria	41	39	17	3	—
Rubella	30	35	32	3	—
Varicella	33	35	28	4	—
Pertussis	34	39	27	—	—
Puerperal sepsis	42	37	21	—	—
Gonorrhoea	20	31	40	8	1
Dental sepsis	26	38	30	6	—
Lobar pneumonia	57	26	15	2	—
Cerebrospinal fever	40	45	14	1	—



M. Nr. 3.

Scale: _____ 20 μ

The five classes in the Arneth or Polynuclear Count. If there is any band of nuclear tissue, except a chromatin filament, uniting the nuclear masses, those parts must not be considered as separate segments.

I, No. 2, II, Nos. 3 and 4, III, No. 4, and IV, No. 5, illustrate this point.

In V, No. 4, the upper segment of the nucleus overlies the segment below it, but the thin chromatin filament uniting them can be seen on the left.

Drawings by M. M. JOHNSON.

As the patient recovers the numbers in the various classes assume normal proportions :—

N.W., Infective Jaundice.

This patient had infective jaundice for five days before the first count was taken.

				I	II	III	IV	V
29. X.26	..	..	..	46	46	8	—	—
5. XI.26	..	..	..	22	56	22	—	—
12. XI.26	..	..	..	18	40	34	8	—
19. XI.26	..	..	..	18	32	42	8	—
8. XII.26	..	..	..	12	30	44	12	2
15. XII.26	..	..	..	10	28	44	16	2

The most rapid return to normal in my experience is the following case of diphtheria in which the count became normal in eighteen days. A child, aged nine years, had a small patch of membrane, the size of a threepenny piece, on the right tonsil caused by *b. diphtheriae*. The polynuclear count was :—

				I	II	III	IV	V
20. XII.14	..	..	..	26	39	32	3	—

Serum was administered at once, and on January 6th, 1915, the count was :—

I	II	III	IV	V
5	31	47	16	1

In attempting to work out the life-history of the polymorph from observations of its behaviour in microbic disease, we are at once confronted with errors due to variations in the amount of toxins absorbed, their neutralization by defensive ferments, and the continuation of marrow stimulation, as obtain in infections.

To obviate these difficulties, Ponder (1926) injected a single dose of a marrowstimulant and followed the polynuclear count to its return to normal.

The experiment and his conclusions are as follows :—

A male rabbit of 1,500 grammes weight was taken. The normal count was ascertained by the examination of 100 polymorphs. Repeated examinations gave the average :—

I	II	III	IV	V
12	34	38	8	8

Fifty milligrammes of dried thyroid were extracted with saline and the whole of the extract injected subcutaneously. This dose of thyroid defects the count very rapidly.

The state of the count on successive days following the injection was :—

Day.			I	II	III	IV	V
1	..	..	46	20	20	7	7
2	..	..	32	36	22	6	4
3	..	..	28	44	18	7	3
5	..	..	18	38	26	10	8
6	..	..	10	28	40	13	9
11	..	..	12	24	36	18	10
16	..	..	11	32	34	10	13
21	..	..	11	34	37	9	9

These figures are represented as curves in fig. 1, the day of observation being noted in each curve.

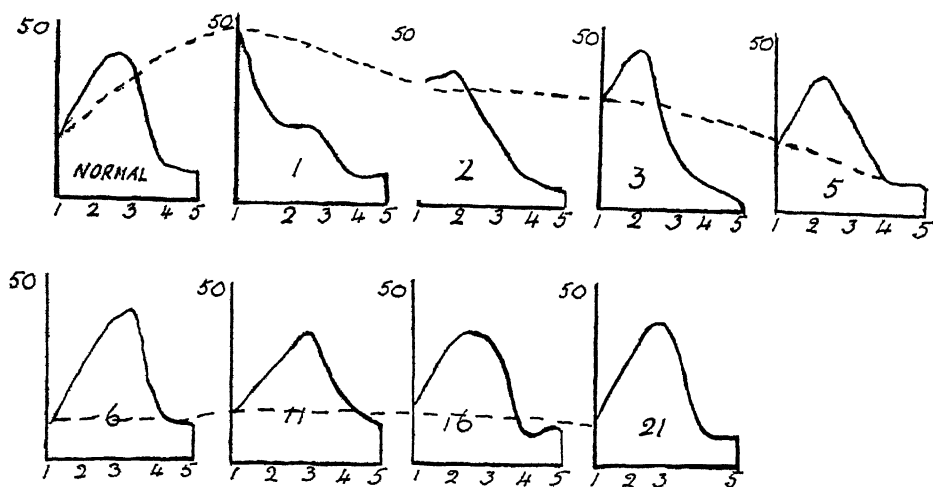
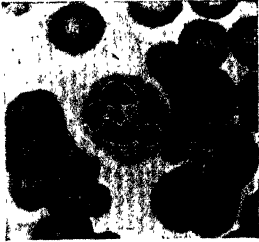


FIG. 1.

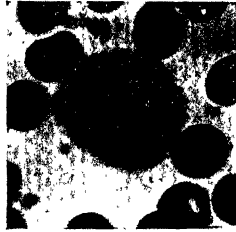
The changes in the count occur in a well marked order. The first effect of the injection is to produce a great increase in the number of polymorphs with simple nuclei. This rise in class I is followed by a maximum in class II on the third day, a maximum in class III on the

EXPLANATION OF PLATE VII.

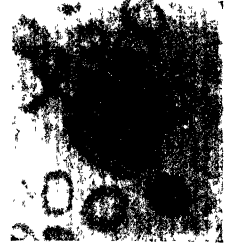
- I.—Normal polymorph. $\times 1000$. Diameter, 11.5μ .
 II and III.—Macropolycytes (Type I) from a case of staphylococcal osteomyelitis. $\times 1000$.
 Diameters, II, 18.5μ . III, 17μ .
 IV.—Macropolycyte (Type I) from a case of streptococcal septicæmia. $\times 1000$.
 Diameter, 19.5μ .
 V and VI.—Macropolycytes (Type I) from a case of a mixed infection. Staph. Aureus and B. Coli. $\times 1000$. Diameters, V, 18μ . VI, 17μ .
 VII and VIII.—Macropolycytes (Type I) from a case of streptococcal endocarditis. $\times 1000$. Diameters, VII, 19μ . VIII, 16μ .
 IX.—Macropolycyte (Type I) pernicious anæmia. $\times 1000$. Diameter 16μ .



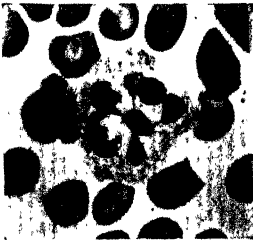
I



II



III



IV



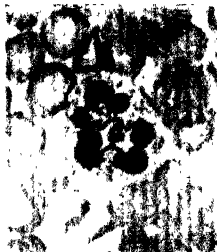
V



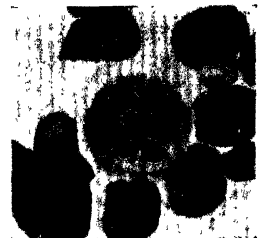
VI



VII



VIII



IX

sixth day, that in class IV on the eleventh day, and in class V on the sixteenth day after the injection. The count is normal within three weeks from the initial deflection.

We have to find the meaning of these changes, and Ponder employs the following reasoning.

The proportions of cells of the various classes can be represented diagrammatically by five squares :—

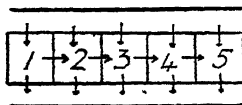


FIG. 2.

The contents of the squares represent the blood stream at any moment, and arrows of the proper size represent cells entering and leaving each class. A cell may enter any class from the one before it, and may leave any class to enter the one after it. A cell may enter a class from without, e.g. the marrow, and may leave any class by death. The space above the squares represents the marrow, and the space below, death or migration from the blood stream.

In the experiment, the increase in numbers of class I, which marks the beginning of the reaction after the thyroid injection, is accompanied by a leucocytosis. This means that a greater number of cells than normally have entered the blood stream.

From the standpoint of fig. 2 we have therefore first to concern ourselves with the upper row of arrows representing the cells which enter the circulation.

We shall first make the assumption that, in the diagram, the middle row of arrows is absent—that is, that there is no progressive development in the blood stream from one class to the class succeeding it. We must now account for the first stage of the reaction by saying that a large number of cells of class I enter the blood from the marrow. On the basis of this assumption these cannot become cells of class II, the decrease in the numbers of class I which follows has therefore to be explained by saying that the cells leave the circulation as cells of class I and are destroyed.

Next we have to explain the increase in the numbers of class II, and must do so in the same way. Numbers of these cells must be liberated from the marrow at a date later than the liberation of the cells of class I, and must pass out of the blood stream, since the rise is succeeded by a fall. And so on for all the other classes. The marrow must be imagined to liberate first cells of class I, then cells of class II, then cells of classes III, IV and V, the liberations being successive in time. When the group of cells of class V has been liberated, the activity of the marrow suddenly stops, although it has been sustained for about two weeks from

the date of the injection. Fig. 3 is a diagrammatic representation of this theory.

This hypothesis could not be seriously upheld. One would require some explanation of the supposed intermittent and selective activity of the marrow. It may be completely disposed of, moreover, because the

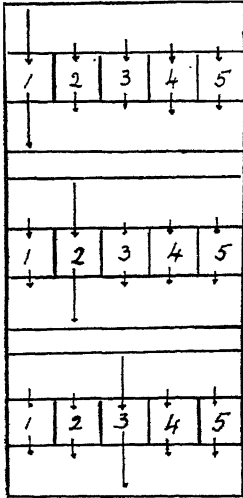


FIG. 3.

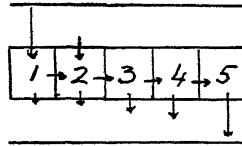


FIG. 4.

marrow does not possess the necessary cells of classes III, IV, and V to liberate in the later stages of the reaction.

We now assume the middle row of arrows to be present, and that there is a progressive development from class to class in the blood stream. The increase in class I is now explained by saying that, as an immediate result of the injection, the marrow liberates cells of class I together with a few

EXPLANATION OF PLATE VIII.

X.—Macropolycytes (Type II) Megakaryocyte type. $\times 1000$. Diameters, lower right, 20μ ; upper left, 17.5μ .

XI.—Macropolycyte, Megakaryocyte type. $\times 1000$. Diameter, 21μ .

XII.—Macropolycytes, Megakaryocyte type. $\times 1000$. Diameters, left, 20.5μ ; right, 15μ .

XIII.—Macropolycyte, Megakaryocyte type with basophil myelocyte. $\times 1000$. Diameter, 20μ .

XIV.—Macropolycyte, Megakaryocyte type. $\times 1000$. Diameter, 20μ .

XV and XVI.—Polymorphs from a case of pernicious anæmia showing hypersegmentation of the nucleus. $\times 1000$. Diameters, 12.5μ .

XVII.—Macropolycyte suggesting a mixed type of Type I and the Megakaryocyte type. $\times 1000$. Diameter, 19μ .

XVIII.—Macro-mast cell showing unusual type of nucleus, approximating to the Megakaryocyte. $\times 1000$. Diameter, 18μ .

Photomicrographs by C. F. HILL and W. E. COOKE.



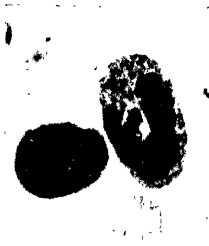
X



XI



XII



XIII



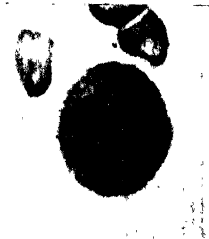
XIV



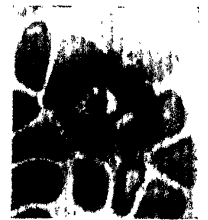
XV



XVI



XVII



XVIII

of class II into the blood stream. Having liberated a number which depends on the dose of thyroid, it does no more. The members of class I now develop into cells of class II; this gives the fall in class I and the rise in class II. The members of class II next develop into cells of class III, and the numbers in this class rise accordingly, and so on. Finally the cells of class IV become cells of class V. These rise to a maximum and then fall in numbers, for they depart from the blood stream by death. In view of the fact that the rises become progressively less as the succeeding classes are entered, it is certain that departures take place from the classes earlier than class V. These we represent by arrows passing out of the row of squares in fig. 4.

The departures are greater in the later classes than in the earlier, and so the arrows increase in size from left to right.

This hypothesis meets the experimental facts. The essential point is the assumption of development in the blood stream, without which no arrangement of the diagram can be made reasonable. Ponder's experiments conclusively prove that the marrow liberates cells of class I and a small number of class II when subjected to stimulation. The cells of the other classes are not liberated because the marrow does not contain them, so they must develop from classes I and II in the blood stream. He proves, too, that the length of life of the polymorph in the blood stream is about twenty-one days.

These conclusions we had surmised on clinical grounds, and Ponder's series of experiments finally settle any doubts.

The duration of life of the polymorph in the blood stream may be taken, then, as about three weeks: its birth-place the bone marrow, its death-bed the stream in which it lived, and its graveyard, probably, the spleen.

THE MACROPOLYCYTE.

No account of the polymorph would be complete if the abnormal types were omitted.

In the normal state and in the vast majority of abnormal states due to microbic infection the potentiality of the hæmocytoblast is unaltered. In other words, it breeds true to type. The myeloblast produces normal cells of the granulocyte group, and the polymorph has, broadly, the same morphological characters in the infective state as it has in the normal state.

But there are conditions in which cells are found that vary from the normal polymorph to such an extent as to merit a special designation. The normal cell measures from 10 to 12 microns in diameter, Plate VII, 1. The cells to which I now refer are giants measuring from 14 to 21 microns in diameter. Sir Humphrey Rolleston, in a letter to me, suggested the descriptive title "macropolycyte." They occur chiefly in two conditions, in the acute pyogenic infections and in pernicious anæmia. I have seen them also in chronic anæmias due to hæmorrhage.

The following are examples of macropolycytes in acute infections. Plate VII, II, III, are from a case of staphylococcal osteomyelitis :—

Total leucocytes, 18,000 per cmm.
Polymorphs, 87 p.c. Myelocytes, 0·5 p.c.

Polynuclear count :—

I	II	III	IV	V
41	43	15	1	—

IV is from a case of streptococcal septicæmia :—

Total leucocytes, 26,000 per cmm.
Polymorphs, 79 p.c. Myelocytes, ·5 p.c.

Polynuclear count :—

I	II	III	IV	V
34	43	21	2	—

V and VI are taken from blood films in a case of a mixed terminal infection by staphylococcus aureus and b. coli :—

Total leucocytes, 23,700 per cmm.
Polymorphs, 88 p.c. Myelocytes, 1·0 p.c.

Polynuclear count :—

I	II	III	IV	V
45	39	15	1	—

VII and VIII are from a case of ulcerative endocarditis due to a streptococcal infection :—

Total leucocytes, 16,000 per cmm.
Polymorphs, 76 p.c.
Myelocytes were present in every blood film.

Polynuclear count :—

I	II	III	IV	V
39	34	27	—	—

Macropolycytes have, as a rule, hypersegmented nuclei, although in the polynuclear count, cells with simple 1 and 2-lobed nuclei markedly predominate, as the foregoing counts show. It will be noticed, too, that in all these cases there is a polymorphic leucocytosis, and myelocytes are present in the peripheral blood, evidence of marrow stress.

The other condition in which macropolycytes are found is pernicious anæmia. In this disease they occur as two distinct types. IX is an example of the first type, and it will be seen to resemble the macropolycyte found in the acute infections.

The second type is illustrated by X to XIV, and will be seen to approximate in size and nuclear conformation, in the older forms, to the megakaryocyte of the bone marrow. I have termed this the megakaryocyte type of macropolycyte.

So far as my own experience goes, I have seen the megakaryocyte type of macropolycyte in cases of pernicious anæmia, only when there has been

a profound toxæmia due to sepsis, associated again with myelocytes in the blood stream.

We have now to consider the life-history of these abnormal polymorphs. I do not think there is any doubt about these cells commencing life in the blood stream as simple nucleated types. x and xii present the early megakaryocyte type, and from comparison with the normal life-history we must conclude that as they grow older their nuclei become hypersegmented. The macropolycyte of infective conditions and the first pernicious anæmia type commence their career in the same way, but, of course, are indistinguishable from the ordinary polymorph until their adult stage is reached. Their length of life we do not know, nor do we know their function, but we can hazard with some degree of confidence the cause of their production and probable genesis.

Danchakoff (1918) concludes from her work on the development of the splenic anlage and other researches, that the factors which govern the potentialities of the hæmocytoblast lie in the conditions of environment, and alteration of that environment leads to alteration in the line of differentiation. This opinion is held by most other workers.

In pernicious anæmia, the disease in which macropolycytes are most frequent, we have evidence of altered potentiality of the hæmocytoblast.

Firstly, the polymorph behaves as in no other disease that I know. In pernicious anæmia there are frequently large numbers of cells of classes IV and V, as comparison between the normal polynuclear count and the count in that disease shows, and the nuclei are, in comparison with the normal nucleus, amblychromatic.

xv and xvi are typical polymorphs showing the hypersegmented nuclelets found in pernicious anæmia :—

Normal Count.

I	II	III	IV	V
10	25	47	16	2

Pernicious Anæmia Counts.

	I	II	III	IV	V
	8	20	39	22	11
	6	27	40	22	5
	7	20	44	24	5
	7	16	29	39	9
	20	31	17	16	16
	16	22	32	16	14
	10	15	38	24	13
	12	34	26	20	8
Average ..	11	23	33	23	10

The polynuclear count is right-handed. Compare the counts in infective states on page 30.

Secondly, in pernicious anæmia the cytoplasm of the polymorph sometimes shows neutrophil or even frankly basophil granules in addition to the usual oxyphil granules. The megakaryocyte type of macropolycyte has neutrophil and azurophil granules.

Thirdly, reversion types of erythroblasts are present in the form of megaloblasts.

Fourthly, alteration in the environment of the hæmocyto blast by irrigation of the marrow of long bones with saline, leads to temporary improvement even in moribund cases.

Fifthly, cells of the granulocyte series show dwarf forms—micropolycytes, micro-eosinophils and micro-basophils.

All these facts point to altered potentiality in the parent cell.

It will be well to remember at this point that Wright (1910–11) has shown the precursor of the megakaryocyte of the marrow to be, in the embryo guinea-pig, a circulatory cell, and he looks upon the megakaryocyte as representing a blood-stream cell in the ancestry of mammals. A glance at Table I shows too, that the megakaryocyte or its precursor must be originally a circulatory cell.

Looking at Table II again, and assuming the dotted lines represent potentiality in addition to morphological characters, we have what, I think, is the correct explanation of the genesis of the macropolycyte.

The hæmocyto blast under altered conditions of environment, in pyogenic infections and in pernicious anæmia, has, to a lesser or greater degree, an altered potentiality, and gives to some myeloblasts a duplex biophore, mostly leucocytic, but partly megakaryocytic, which shows itself either in the first type of macropolycyte if the bias is leucocytic, or with megakaryocytic bias, in the megakaryocyte type of macropolycyte.

As a proof of this contention xvii suggests this cell to be a mixture of both types of macropolycyte, a condition not very infrequently seen in films when macropolycytes are found.

To complete the argument in favour of the theory of altered potentiality of some hæmocyto blasts in acute infections and in pernicious anæmia, reference to the other granulocytes of the blood stream must be made.

In cases of neutrophilia the eosinophil cell tends to disappear from the blood stream, and I have not found any very abnormal form in the acute infections. But, in pernicious anæmia, both when there is a leucopenia and when there is a leucocytosis, abnormal eosinophils are common. The micro-eosinophil as small as 5μ in diameter is not infrequent, while larger cells showing much more segmentation in their nuclei than normal are fairly common.

The large eosinophils have as many as six or seven nuclear segments, and the cell body may measure up to 16μ in diameter.

Finally, the mast cell is sometimes found behaving as if its parentage was in doubt.

Normally, this cell is found in 60 p.c. of people to the extent of about

0·3 p.c. of white cells. It measures 8 to 10 μ in diameter, and has a rounded or clover-leaf nucleus. Occasionally, in cases of marrow stress, one sees a giant, with a polymorphous nucleus.

XVIII is a macro-mast cell found in the case of broncho-pneumonia. having the following white cell count :—

Total leucocytes, 33,600 per cmm.
Polymorphs, 86 p.c.
Mast cells, 1 p.c.
Occasional myelocytes were present in the blood films.

Polynuclear count :—

I	II	III	IV	V
42	37	17	4	—

To sum up in a few words, we have seen that the polymorph arises originally in the extra-embryonic tissue, the blood islands of the yolk sac, its parent cell, the myeloblast, with its sister, the megakaryocyte, becoming, after the third week, blood stream cells.

Its life-history in the blood stream in post-natal life is told by its age as indicated by the alteration in the number of its nuclear segments, and by following these changes in infective states, or as Ponder has done by injection of a marrow stimulus, its length of life is seen to be about three weeks.

Under conditions of stress in the acute infections, and in pernicious anæmia, we have seen that some hæmocyto blasts have an altered potentiality giving rise to abnormal cells of the granulocyte group, which approximate to a lesser or a greater degree, the megakaryocyte of the bone marrow.

I must take this opportunity to express my thanks to two fellows of the Society for their invaluable aid, not only in this communication, but in many others.

The lantern slides are testimony of Mr. Bradbury's skill. To our treasurer, Mr. Cyril F. Hill, I owe a debt of gratitude too great to express in words. Only by his meticulous care, his infinite capacity for taking pains, could the macropolycyte have been presented as you have seen it to-night.

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of C. DA FANO, M.D.)

STAINING AND IMPREGNATION METHODS.

New Dye for Intra-Vitam Staining.—L. VARGA ("Untersuchungen über die Anwendung eines neuen Farbstoffes auf dem Gebiete der Vitalfärbung," *Ztschr. f. wiss. Mikrosk.*, 1926, 43, 338–45). "Spirsil," the new dye recently proposed by Szilvasi for staining *Spirochæta pallida* and for other bacteriological purposes, can be employed with great advantage for the *intra-vitam* staining of Rotatoria as well as of certain species of Hydrozoa, Ostracopoda and Cladocera. A small quantity of a solution of spirsil 1 : 32 to 1 : 64 is added to the hanging drop of water containing the objects under investigation. Some cells take the stain only after 10–20 minutes and can be recognized by their pinkish-red colour; other cells stain in subsequent periods of time. Nuclei stain only when the animals are dying.

C. DA FANO.

Method for Staining Medullated Nerve Fibres in Frozen Sections.—H. SPITZER ("Eine neue Methode der Markscheidenfärbung am Gefrierschnitt," *Ztschr. f. wiss. Mikrosk.*, 1926, 43, 110–11). Frozen sections from formalin material are mordanted for 1 hour in a 30 p.c. alcoholic solution of iron chloride and then washed in 95 p.c. alcohol. They are then stained for 6–12 hours in Mallory's phosphotungstic hæmatoxylin, washed in water and differentiated for about half a minute in 1 p.c. oxalic acid. At this moment they can be washed once more, dehydrated and mounted in the usual way; the medullated nerve fibres are stained blue on a red background. If it is desired to have a white background, the sections after the last washing are passed for half a minute through a dish of water to which a few drops of ammonia have been added; wash; 95 p.c. alcohol, carbonyl, balsam.

C. D. F.

Impregnation of Central and Peripheral Nerve-Endings.—S. R. CAJAL ("Une formule pour colorer dans les coupes les fibres amédullées et les terminaisons centrales et périphériques," *Trav. Lab. Rech. Biol.*, 1925–6, 23, 237–40). Frozen sections (30–40 μ thick) from formalin material are collected in distilled water, washed and transferred for 4–6 hours into an impregnating bath consisting of 10 c.c. of 2 p.c. AgNO_3 , 7–10 drops of pyridin and 5 or 6 c.c. of 96 p.c. alcohol. They should assume a light brown colour which can be intensified by placing the dish over a flame for a few minutes. The sections are then quickly washed (no more than two or three at a time) in 96–98 p.c. alcohol and immediately afterwards reduced in a bath consisting of 0.30 gm. of hydroquinone, 70 c.c. of distilled water, 20 c.c. of formalin and 15 c.c. of acetone. After a few minutes they can be washed, toned with a gold chloride solution, fixed with sodium hyposulphite, washed once more and mounted in the usual way.

For the impregnation of the pericellular baskets, moss and climbing fibres of

the cortex cerebelli, it may be useful to have resort to a simplification of the above method by carrying out the impregnation and reduction at the same time. The *modus operandi* is as follows: Frozen sections from formalin material are washed and passed into a bath consisting of 10 c.c. of 2 p.c. AgNO_3 , 10 drops of pyridin and 7-10 drops of formalin. After 4-6 hours they should be dark brown, when they can be washed, toned, fixed and mounted. This simplification is not recommended for tissues from man or rabbit.

C. D. F.

Preparation of the Ammoniacal Silver Nitrate Solution for Impregnation Methods.—B. J. DEIKUN ("Über die Herstellung der ammoniakalischen Silberlösung bei Imprägnationsmethoden," *Ztschr. f. wiss. Mikrosk.*, 1926, 43, 382-4). The test tube for preparing the AgNO_3 solution must be chemically clean. For this purpose it should every time be cleaned with a mixture of $\text{KMnO}_4 + \text{H}_2\text{SO}_4$ and then washed first with tap water and then with distilled water. The necessary reagents should be chemically pure. The solution must be freshly prepared at the moment of use. 2 c.c. of a 10 p.c. solution of AgNO_3 are poured into the test tube and one drop of 40 p.c. NaOH added to it. Shake gently and wait for the precipitate to fall to the bottom of the tube; add another drop of 40 p.c. NaOH , shake once more and let the precipitate fall to the bottom of the tube; repeat the operation a third and a fourth time until no precipitate is formed on adding NaOH . The supernatant clear portion of the fluid is now eliminated and the precipitate washed with 100-150 c.c. of distilled water. One should go on washing it until the wash water no longer turns an alcoholic 1 p.c. solution of phenolphthalein red. The wash water is as far as possible eliminated and ammonia added drop by drop to the precipitate until it is almost, but not entirely, dissolved. After the addition of 4 c.c. of distilled water the fluid is ready for use. Should it be desirable to eliminate all traces of undissolved precipitate, the fluid can, before use, be centrifuged. Its filtration through glass-wool, as suggested by Schlemmer, is, according to the author, of no advantage.

C. D. F.

Impregnation of the Nervous System after Fixing and Decalcifying at the same Time.—F. DE CASTRO ("Technique pour la coloration du système nerveux quand il est pourvu des ses étuis osseux," *Trav. Lab. Rech. Biol.*, 1925-6, 23, 427-46, 8 text-figs.). Small pieces should be fixed and decalcified at the same time in one or the other of the following mixtures: (1) Chloral hydrate 2.5 gm., distilled water 50 c.c., 96 p.c. alcohol 50 c.c., nitric acid 3-4 c.c. (2) Urethane 1-2 gm., distilled water 40 c.c., 96 p.c. alcohol 60 c.c., nitric acid 3-4 c.c.; (3) Somnifène (Hoffman La Roche) 2-4 c.c., 96 p.c. alcohol 60 c.c., distilled water 40 c.c., nitric acid 3-4 c.c. After 1-3 days, decalcification is complete particularly if the pieces are very small and from very young or fetal mammals. They are washed in distilled water for 24-36 hours to extract the nitric acid, and then transferred into 96 p.c. alcohol containing 4-6 drops of ammonia for every 50 c.c. of alcohol. After 24 hours they are silvered, reduced and embedded as by the well-known method of Cajal. Some pieces may not be silvered after washing, but simply dehydrated and embedded either in celloidin or paraffin; the sections can then be stained by ordinary methods.

C. D. F.

Alum Carmine for Counter-Staining Weigert-Pal Preparations.—J. ANDERSON (*J. Path. and Bact.*, 1926, 29, 117). Put 1 gm. of pure carmin in a 200 c.c. flask and add 10 c.c. of absolute alcohol; mix thoroughly. Add 5 c.c. of a 2 p.c. solution of chloride of lime and mix again. Add 90 c.c. of a saturated

solution of ammonia alum and shake well. Bring the mixture to the boiling point shaking several times while it is heating; boil for 1 minute and filter. After filtering and cooling add 5 c.c. of acetic acid and keep the stain in a well-stoppered bottle. It seems to last indefinitely; it should be filtered back into the bottle after use. The sections after having been stained and differentiated by the Weigert-Pal method, are washed in water and placed in the carmin stain for 2-3 hours at 50° C. They are then washed until the celloidin is a faint pink colour, dehydrated and mounted in the usual way. As the carmin solution acts as a weak differentiator of hæmatoxylin, it is well not to carry the decolorisation by Pal's method quite so far as usual.

C. D. F.

GENERAL CYTOLOGY.

Structure and Energy Production in Protoplasm.—MONTROSE T. BURROWS ("Energy Production and Transformation in Protoplasm as seen through a Study of the Mechanism of Migration and Growth of Body Cells," *Am. J. Anat.*, 1926, 37, 289-349, 5 text-figs., 2 pls.). Many body cells appear to be simple drops of fluid cytoplasm in which float centrosomes, mitochondria, other formed bodies and a fluid nucleus. They are pure protoplasmic systems possessing no evidence of other fixed structures, and acting as simple physicochemical complexes which may react with their environment. These reactions proceed always to a state of equilibrium. The active manifestations of life in these cells are primarily the result of their initiating or catalysing certain chemical changes. A substance, the "archusia" (S), is liberated in this process. The archusia acts in turn on the cell to produce various kinds of changes which are related to its immediate concentration. In low concentrations (S¹) the archusia has no effect. In medium concentrations (S²) it causes the cell to liberate a lipoid substance, the "ergusia." This has strong affinities for the cell as well as for proteins and fats in the environment. Mobile proteins and fats absorbing the ergusia are drawn into the cell while the cell is drawn into fixed proteins and towards larger masses of fat. In high concentrations (S³) the archusia induces a digestion of the proteins and fats, an active absorption of water by the cells, synthesis of protoplasm, growth and division. In all higher concentrations (S⁴) the archusia causes the cells themselves to undergo liquefaction. The archusia (S) is readily soluble in isotonic salt solutions, serum, plasma and blood. The cell has no means of retaining its archusia which is always lost to the medium. Its concentration in and about the cell is therefore determined by the environment. The cells grow independently only when they are crowded into a small stagnant mass of medium where their archusia is retained at a concentration of S³. Cancer is the result of crowding of cells together in a small area in the body and a relative reduction in the blood supply to the mass. The mechanism of growth in these cells is the result of the forcible pulling of proteins and fats into their cytoplasm, accomplished through the liberation of ergusia. Migration is merely a modification of this act of growth. In overcrowded environments the archusia reaches a concentration of S⁴ in the centre of the mass where the cells undergo liquefaction. The liberated liquid spreads as a film over the surface of the medium, and the border cells invade this film readily. Only under these conditions of overcrowding can these cells move at a water surface. They move, as Quincke deduced, by liberating a lipoid-like substance which decreases their surface tension. This decrease, however, is not at the cell water interface but at the cell-protein, cell-fat and other cell interfaces having like affinities. Function is the result of a polarisation of the cell or conditions which allow the archusia to accumulate only at one side of the cell. In the body this

polarisation is due to a peculiar arrangement of blood vessels and cells. The functioning cells are so arranged that one of their ends is bathed by blood, the other lies in a more stagnant region where the archusia can concentrate about it.

C. D. F.

Golgi Apparatus in the Cells of Langerhans Islets.—R. J. LUDFORD and W. CRAMER ("Secretion and the Golgi Apparatus in the Cells of the Islets of Langerhans," *Proc. Roy. Soc. Lond.*, (B), 1927, 101, 16-24, 23 text-figs., 1 pl.). The Golgi apparatus of the cells of the islets of Langerhans of the mouse and rat varies considerably in size, shape, and arrangement. These variations appear to be correlated with different phases of secretory activity, and can be observed in animals kept under ordinary laboratory conditions at the same time as other morphological changes of the same cells. More striking cytological changes are associated with pregnancy and, in a less degree, after prolonged exposure to heat. After intense secretory activity the Golgi apparatus may break up into fragments, and thus contribute to the formation of the specific secretory products of the islet's cells.

C. D. F.

Mitochondria in *Noctiluca Scintillans* (Macartney, 1910).—D. CAUSEY (*Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 12), 225-30, 1 pl.). The mitochondria present in *Noctiluca scintillans* are of two types: rod-shaped and spherical. The former are associated with food vacuoles and correlated with the anabolic activities of the organism; the latter occur in the remaining parts of the cytoplasm, including the tentacle, and are correlated with the katabolic activities of the organism.

C. D. F.

Mitochondria and Golgi bodies in *Entamoeba gingivalis* (Gros) Brumpt.—D. CAUSEY (*Univ. Calif. Pub. Zool.*, 1925-6, 28 (No. 1), 1-18, 3 pls.). Using smears fixed in osmic acid vapours, and fresh material stained vitally with Janus green B, Scharlach R, and Sudan III, the author believes that he has demonstrated mitochondria, Golgi bodies, and fat bodies in *Entamoeba gingivalis*. Mitochondria are evenly distributed through the cytoplasm. During digestion (anabolic activity) rod-shaped mitochondria appear *de novo* around the food vacuoles. The fat bodies lying in vacuoles in the cytoplasm seem to be formed by clumping and fusion of the mitochondria. Spherical mitochondria are associated with all movement (catabolic activity). The first sign of pseudopod formation is a solution of part of the ectoplasm, shown by the Brownian motion of the mitochondria. During protrusion or retraction the pseudopodium remains in the sol condition, the rest of the cytoplasm being in the gel condition, to which the pseudopodium reverts when fully formed. The author supports Regaud's view that mitochondria are metabolic products, playing the part of plasts. The walls of food vacuoles which are disappearing may fade out uniformly, or material may be concentrated at one side, forming a crescentic thickening interpreted as the Golgi element. These may elongate and become twisted, resembling metazoan Golgi bodies; they stain intensely, but disappear after Schaudinn fixation. A probability of spiral organisation is indicated by the arrangement of the mitochondria in small amoebae with few food vacuoles.

S. D. KING.

The Albuminoid Inclusions of the Fat Body of Insects.—A. PAILLOT and R. NOEL ("Sur l'origine des inclusions albuminoïdes du corps adipeux des insectes," *Compt. rend. Acad. d. sc.*, 1926, 182, 1044-6, 3 text-figs.). Mitochondria present in the cells of the fat body of *Pieris brassicae* and *Bombus* swell up in

ecdysis to form albuminoid masses. Regeneration of the mitochondria follows by shrinkage of these masses. During pupation a similar cycle is observed, and albuminoid bodies of mitochondrial origin also appear in parts of the fat body during induced fasting.

S. D. K.

Mitochondria in Ciliates.—D. CAUSEY ("Mitochondria in Ciliates with Special Reference to *Paramecium caudatum* Ehr.," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 13), 231-50, 3 pls.). The presence of mitochondria in ciliates has been reported by several authors, of whom Fauré-Fremiet is the most prominent. A list of species is given in Cowdry's monograph on mitochondria (1918). To this list the following are now added by Causey: *Chaenea teres* Duj., *Microthorax sulcatus* Eng., *Colpoda saprophylla* Stokes, *Stylonychia pustulata* Ehr., and *Euplotes patella* Ehr. The rod-shaped mitochondria occur in and about the food vacuoles throughout binary fission and conjugation. There is no evidence for the division of the mitochondria during division of the micronucleus or of the cell proper; they appear to arise *de novo*. The granules of the neuromotor system of Protozoa appear to derive from spherical mitochondria, modified chemically so as to be more resistant to acetic acid.

C. DA FANO.

Mitochondria in Euglena Gracilis Klebs.—D. CAUSEY (*Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 11), 217-24, 2 pls.). The mitochondria present in *Euglena gracilis* are spherical in form. A definite ratio appears to exist between the volume of the cytoplasm and the number of mitochondria. The pyrenoids, which secrete paramylum, indicate by their staining reactions that they are mitochondrial in origin and comparable to the parabasal bodies of parasitic flagellates. The mitochondria arise *de novo*, and do not have a persistent identity during the life of the organism.

C. D. F.

Mitochondria and Golgi's Apparatus.—VISHWA NATH ("On the present Position of the Mitochondria and the Golgi Apparatus," *Biol. Rev. and Biol. Proc. Cambridge Philos. Soc.*, 1926-27, 2, 52-79). In the present state of our knowledge it is not possible to make any general statement as regards the functions either of the mitochondria or the Golgi apparatus. Even if we consider them as self-perpetuating bodies in the cytoplasm, which is yet to be finally proved (although the available evidence points towards that conclusion), the possibility remains that they may arise *de novo*. Nor can they be regarded as purely passive bodies like yolk spheres, as is clearly shown by their grouping round the centrioles and their subsequent distribution, their orientation towards the poles or the equator of the spindle in certain cases of mitosis, their polymorphic form, their activity in secretory processes, and at least in the case of mitochondria, their movements in the cytoplasm.

C. D. F.

Acceleration of Cell-Division by Temperature.—B. EPHRUSSI ("Sur l'accélération inégale des différentes phases de la division cellulaire par l'élévation de la température," *Compt. rend. Acad. d. sc.*, 1926, 182, 810-12). Experiments on the egg cells of *Paracentrotus lividus* and *Ascaris megaloccephala*. A rise in temperature influences differently the various phases of mitotic division; the formation of the equatorial plate, and the reconstitution of the daughter nuclei being accelerated more than the other phases.

C. D. F.

A. VERTEBRATA.

Embryology, Evolution, Heredity, Reproduction, and Allied Subjects.

Polynuclear Ova and Polyovular Follicles.—C. G. HARTMAN ("Polynuclear Ova and Polyovular Follicles in the Opossum and Other Mammals, with Special Reference to the Problem of Fecundity," *Am. J. Anat.*, 1926, 37, 1-42, 4 pls.). A survey is made of the occurrence of polynuclear ova and polyovular follicles in mammals. Such structures are found sporadically in the ovaries of most species, but usually only rarely, except in the case of the dog, where their occurrence is fairly common. The doubling of nuclei and of ova is the most common form of these abnormal follicles, but much larger numbers up to nine, ten or thirteen ova per follicle, or up to five germinal vesicles per ovum, are recorded. Such follicles are usually primordial, but some cases have been recorded where a considerable accumulation of liquor folliculi was present.

A. S. PARKES.

Oogenesis in the White Rat.—M. H. COWPERTHWAIT ("Observations on Pre- and Post-Pubertal Oogenesis in the White Rat, *Mus Norvegicus Albinus*," *Am. J. Anat.*, 1925-6, 36, 69-89, 1 pl.). Synapsis is completed by the fourth day post partum. The cortical follicles remain in a retarded state of development long after the medullary follicles have matured or undergone atresia. Before or after puberty, no germinal epithelial cells were observed to undergo meiosis or to enlarge *in situ*. After the attainment of sexual maturity, no evidence of a cyclical proliferation of new germ cells from the germinal epithelium was found. Consequently the relation of young follicles of mature ovaries to the surface is not constant. The growth *in situ* of certain cells of the germinal valleys may account for the production of young follicles in mature ovaries. The central cells of such follicles have a nuclear picture resembling that of those in which meiosis is known to have occurred. It is improbable that the cells which enlarge *in situ* have become differentiated from post-meiotic germ cells. If synapsis be the criterion of the definite oocyte, the central cells of the young follicles of mature ovaries cannot be considered true oocytes, and oogenesis is not continued throughout pre- and post-puberal life.

C. DA FANO.

Origin of the Germ Cells in Trionyx.—C. S. SIMKINS (*Am. J. Anat.*, 1925-6, 36, 185-213, 4 pls.). No germ glands or germ cells arise in association with the pronephros of Trionyx. Large cells found here and there are less startling when accurately measured and compared to other cells of different regions of the embryo and at different ages. Isolated blood cells before the origin of the germ-gland rudiment more nearly answer to the requirements of primordial germ cells than any other cells encountered. Large cells containing products of yolk metabolism appear to belong to the hæmatopoietic rather than the germ line. Migration of large yolk-laden cells from the entoderm to the embryo conveying unaltered yolk is not credible. Gonocytes arise from the rudiments of the sex glands during the development of the mesonephros, either from the stroma or from the generative epithelium. There is no evidence in favour of the extraregional origin of primordial germ cells in Trionyx.

G. D. F.

Partenogenesis Due to Hypertonic Sea-Water.—E. BATAILLON ("Le processus membranogène et le développement régulier provoqués chez les œufs vierges d'échinides par le seul traitement hypertonique," *Compt. rend. Acad. d. sc.* 1926, 182, 1508-11). Of unfertilised eggs immersed for 20-40 minutes in concentrated sea water, viz. containing 76-79 NaCl per 1000 of fluid, 75 p.c. produced

membranes, and of these membranes 60 p.c. were detached after restoration of the eggs to ordinary water. Shrivelling of the membrane can be induced by albumin water. The egg of *Sphaerechinus* gives the best results. The actual production of membranes is not affected by temperature variations between 15 and 20° C., but the necessary time of immersion in hypertonic saline is greater for the lower temperature. C. D. F.

The Rabbit Placenta.—H. W. MOSSMAN ("The Rabbit Placenta and the Problem of Placental Transmission," *Am. J. Anat.*, 1926, 37, 433–98, 25 text-figs.). Rabbits in different stages of gestation were killed by coal gas, and the whole uterus, after ligation of vessels, was fixed in Bouin's picro-formol. Serial paraffin sections were stained with Delafield's hæmatoxylin and eosin. Rabbits were also killed by coal gas, washed out with saline containing 0.1 p.c. sodium nitrite, and injected with 10 p.c. gelatin to which granular pigments or transparent colours were added. The author recommends 15 p.c. solutions of metagelatin. Gelatin solution is acidified with acetic acid and heated for several hours. This is then neutralised with ammonia, and the metagelatin does not coagulate on cooling, so allowing injections to be made at room temperature. With clamped vessels subsequent immersion in formalin hardens the metagelatin and fixes the tissues. The maternal arterial vessels of the earlier stages have much thicker perivascular sheaths than the veins; later the arteries become surrounded by thick sheaths of multinucleate cells in the maternal portion of the placenta, and from the 22nd day onwards these sheaths extend even into the musculature. The venous sinuses, which in the earlier stages are much larger than the arterial channels, become reduced in the last days of gestation by cylindrical clots of fibrin. C. D. F.

Ovary of Mouse and X-Rays.—(A) F. W. R. BRAMBELL, A. S. PARKES and U. FIELDING ("Changes in the Ovary of the Mouse following Exposure to X-Rays. Part I. Irradiation at Three Weeks Old. Part II. Irradiation at or before Birth," *Proc. Roy. Soc. Lond.*, (B) 1927, 101, 29–56, 7 text-figs, 4 pls. and 71–114, 3 pls.). (B) A. S. PARKES ("On the Occurrence of the Oestrous Cycle after X-Ray Sterilisation. Part I. Irradiation of Mice at Three Weeks Old. Part II. Irradiation at or before Birth," *Proc. Roy. Soc. Lond.*, 1926, 100, 172–99, 3 pls. and 1927, 101, 71–95, 1 pl.). Irradiation of mice with a full sterility dose of X-rays at three weeks old is followed by the degeneration of all the oocytes. The membrana granulosa and the theca interna, when differentiated, degenerate also. Finally, the old follicles are only represented by cavities containing remnants of the zona pellucida. In a few cases the larger follicles become filled with blood and form cysts, or the cells of the theca interna and membrana granulosa grow and, invading the antrum, form a corpus luteum atreticum. These corpora lutea atretica persist indefinitely but have no influence on the oestrous cycle. Simultaneously with these changes the old interfollicular tissue atrophies and the germinal epithelium proliferates epithelial cords. In the adult animals the ovaries are composed almost entirely of this first proliferation; it tends to become like luteal tissue in some cases. Sometimes a second proliferation from the germinal epithelium follows. This consists of small, spherical or slightly elongated cords which resemble the so-called spermatoc cords described in the ovaries of inbred rabbits (Hammond) and of free-martin cattle, as well as structures described as anovular follicles. The cords of the second proliferation appear to have no effect on the oestrous cycle. Since none of the above animals have oocytes, follicles or follicular tissue, it is concluded that the cyclic structures of the ovary are not essential for the occurrence of the normal cyclic activity of the uterus and vagina. Perhaps the oestrus-

producing hormone is elaborated by the inter-follicular tissue, though also possibly by the follicles under normal conditions.

Irradiation in utero or at birth leads to similar results, the degeneration of the oocytes and follicles being followed by two successive proliferations from the germinal epithelium in the form of cords, and some of the degenerating follicles producing cysts or corpora lutea atretica. The latter may persist indefinitely but have no effect on the oestrous cycle. Of the animals irradiated at birth 24 were allowed to become adult. The cords of the first proliferation constituted the bulk of all the ovaries, and those of the second proliferation were only found in 11 of the cases. Follicles were completely absent in all but one case. These 24 animals are divided into 3 groups. (a) The cells of the first proliferation are small, shrunken and vacuolated. The oestrous cycles were irregular and in some cases prolonged vaginal cornification occurred. (b) The cells of the first proliferation are large, healthy and glandular in character and somewhat resemble luteal tissue. The oestrous cycles were normal and regular. (c) The cells of the first proliferation very closely resemble luteal tissue. The oestrous cycle was absent or had ceased for at least 36 days before the animals were killed. It is concluded that the cells of the first proliferation are mainly responsible for the production of oestrin and the regulation of the oestrous cycle. The production of oestrin appears to stop when the differentiation into luteal-like cells attains a certain degree.

C. D. F.

Changes in the Vaginal Mucosa.—K. M. WILSON ("Histological Changes in the Vaginal Mucosa of the Sow in Relation to the Oestrous Cycle," *Am. J. Anat.*, 1926, 37, 417–31, 2 pls.). Shortly before oestrus the vaginal mucosa of the sow shows various phenomena of growth and proliferation; these reach their maximum at the oestrus. Subsequently a formation of rather large vacuoles is observed but without a true cornification of cells as seen in the rat and guinea-pig. From time to time throughout the oestrus cycle irregular migrations of leucocytes and mononuclear cells into the subepithelial and epithelial layers are noticed.

C. D. F.

Embryogenesis of Bile Capillaries.—W. BLOOM ("The Embryogenesis of Human Bile Capillaries and Ducts," *Am. J. Anat.*, 1925–6, 36, 451–65, 5 text-figs.). In human embryos stained by Eppinger's method bile capillaries are present in large numbers at 10 mm., viz. much earlier than they have previously been demonstrated. The large lumina described by Toldt and Zuckerkandl as embryonic capillaries are present in very young embryos and should be sharply distinguished from the true bile capillaries. They are probably embryonic canaliculi from which the true bile capillaries arise, or they may be dilated spaces due to the confluence of many capillaries. The system of excretory ducts develops *in situ* from liver-cell cords and seems to assume its typical cubical epithelium under the influence of the ingrowth of young connective tissue along the branches of the portal vein. No evidence of intracellular branches of the bile capillaries was found.

C. D. F.

Growth of the Kidney and Kidney after Unilateral Nephrectomy.—M. ARATAKI (I. "On the Postnatal Growth of the Kidney with Special Reference to the Number and Size of the Glomeruli (Albino Rat)." II. "Experimental Researches on the Compensatory Enlargement of the Surviving Kidney after Unilateral Nephrectomy (Albino Rat)," *Am. J. Anat.*, 1925–6, 36, 399–36 and 437–50). (I.) At birth there are in the male albino rat some 10,700 glomeruli; at maturity 31,000; in the senescent 500-day rat, about 20,000. The value for

the female is only 0.2 per cent. below that for the male. The formation of glomeruli is very active during the first 35 days but continues up to 100 days at least. Comparison of these data with those for the rabbit suggests that the number of glomeruli increases in proportion to the increase in body weight. The diameters of the glomeruli range in the male from $62\ \mu$ at birth to $124\ \mu$ at 500 days. This shows that enlargement of the glomeruli is one method of functional adjustment. (II.) The enlargement of the surviving kidney after unilateral nephrectomy is mainly due to the hypertrophy of the glomerular system and to the lengthening of the convoluted and collecting tubules; however also the supporting tissue is hyperplastic, and in some measure the cells lining the tubules likewise show hypertrophy and hyperplasia.

C. D. F.

Development of Hypophysis in Man.—W. J. ATWELL ("The Development of the *Hypophysis Cerebri* in Man with Special Reference to the *Pars Tuberalis*," *Am. J. Anat.*, 1926, 37, 159-93, 2 text-figs., 7 pls.). The earliest appearance of the paired lateral lobes which form the *pars tuberalis* of the *hypophysis cerebri* in man were observed in a 10.5 mm. embryo. At this stage they exist as ridges at the anterolateral angles of the hypophysial evagination near its attachment to the mouth epithelium. In stages in which the epithelial stalk is a small tube or is solid (14-18.5 mm. embryos), the lateral lobes appear as two epithelial shelves, one on each side of the attachment of the epithelial stalk to the body of the gland. Following the separation of the stalk and the cupping of the epithelial hypophysis, the lateral lobes lie at the nasal brim of the hypophysial cup. Subsequently they fuse across the mid-line and form the *pars tuberalis*, which by the 45 mm. stage grows forward and backward surrounding the infundibulum and spreading out under the tuber cinereum. The *pars intermedia* develops from the apex of Rathke's pouch. A deep incisure separates the *pars tuberalis* from the *pars intermedia* until late foetal stages.

C. D. F.

Histology.

Thymus of Thyroid-Treated Tadpoles.—C. C. SPEIDEL ("Studies in Hyperthyroidism. II. The Significance of Changes in the Thymus Gland of Thyroid-Treated Frog Tadpoles," *Am. J. Anat.*, 1926, 37, 141-158, 2 text-figs., 2 pls.). The normal thymus of frog tadpoles consists almost entirely of lymphoid aggregations interspersed with large blood sinuses; they function as lymphocytopoietic organs. After administration of thyroid extract to the tadpoles, the lymphocytes, especially the larger ones, are stimulated to mitotic proliferation. The blood sinuses become reduced in size. The hyperplasia of the lymphoid cells is followed by their migration into the blood sinuses and thence into the general circulation. The increased production of lymphocytes is not peculiar to the thymus but occurs in many regions of the body; thus there is a general lymphoid reaction to hyperthyroidism. This reaction is considered by the author as a preliminary phase of the response on the part of the body to supply cells of a relatively undifferentiated type (lymphocytes), which in the tadpole and frog function as mother-cells for erythrocytes, granulocytes and monocytes.

C. DA FANO.

Fate of Extruded Erythrocytes.—E. R. and E. L. CLARK ("The Fate of Extruded Erythrocytes: their Removal by Lymphatic Capillaries and Tissue Phagocytes as seen in Living Amphibian Larvae," *Am. J. Anat.*, 1926-7, 38, 41-70, 8 text-figs.). Erythrocytes remain intact in the tissue spaces unless removed by blood or lymphatic endothelium or phagocytes. Their removal is usually effected either by lymphatic capillaries or by pigmented mononuclear wandering cells which appear to be the equivalent in Amphibia of the clasmatoocytes or histiocytes

of mammals. Lymphatic capillaries respond at once to the presence of erythrocytes in the tissue spaces and, if near enough, start the process of drawing the blood cells into their interior within an hour or two after the extravasation is produced, while the wandering cells do not phagocytose them until they have been in the tissue spaces at least 15 hours. Within the wandering cells the erythrocytes gradually disintegrate and are apparently digested. In very young tadpoles the blood vessel endothelium possesses the capacity of sending out sprouts towards extravasated erythrocytes, and of transferring them to their lumen in the same way as lymphatic capillaries. C. D. F.

Testis Graft Reactions.—C. R. MOORE ("On the Properties of the Gonads as Controllers of Somatic and Psychological Characteristics. IX. Testis Graft Reactions in Different Environment (Rat)," *Am. J. Anat.*, 1926, 37, 351-416, 15 text-figs.). Whole rat testes were found to persist after transplantation into normal or castrated males, normal or spayed females for periods ranging from one to six and one-half months. Persistence of grafts in the different groups varied, but no great significance is attached to the varying percentage of persistence. Testis grafts in all groups may be of different types as regards the tissue reactions; no specific tissue reaction is definitely associated with any type of animal. In all one may find grafts (1) with an apparent increase in interstitial cells; (2) without this apparent increase; (3) with seminiferous tubules carrying on early stages of spermatogenesis; (4) with tubules containing only Sertoli cells; (5) with varying combinations of these conditions. Testes transplanted into the scrotum may carry on spermatogenesis to completion and produce spermatozoa. C. D. F.

Testis in Scurvy and Inanition.—B. LINDSAY and G. MEDES ("Histological Changes in the Testis of the Guinea-pig during Scurvy and Inanition," *Am. J. Anat.*, 1926, 37, 213-35, 2 pls.). A diet deficient in vitamin C causes a degeneration of the seminal epithelium of the testes of guinea-pigs. An inadequate food supply has the same effect. The type of degeneration is similar to that due to exposure to X-rays, vitamin B deficiency or inanition in rats, elimination of the action of the sympathetic nerve supply in dogs and vitamin deficiency in pigeons and monkeys. The signs of degeneration within the tubules of the testes include reduction of spermatogenesis and desquamation of the germinal epithelium with cytoplasmic disintegration. The cells in the later stages of spermatogenesis degenerate first. The extent of degeneration is uneven. The Sertoli cells are not affected, and no hypertrophy of the intertubular tissue is observed. The interstitial cells seem to lack distinct granules in their cytoplasm. C. D. F.

Regeneration in the Pancreas of the Rabbit.—T. P. GRAUER (*Am. J. Anat.*, 1926-7, 38, 233-53, 6 text-figs.). The pancreas of the rabbit is a highly plastic organ capable of undergoing structural changes with astonishing rapidity. In one case the pancreas was reduced to a system of branching ducts and restored, within the space of only 25 days, to an almost normal condition. In another rabbit killed in an early phase of regeneration, the large number of mitoses present was equal to that found in a rapidly growing embryo; this accounts for the rapidity of restoration. Although various authors have shown that pancreatic acini tend to regenerate even while the duct is occluded, regeneration proceeds without complicating regressive changes only when the patency of the duct into the bowel is re-established. C. D. F.

The Pancreatic Bladder.—E. A. BOYDAN ("The Problem of the Pancreatic Bladder.—A critical Survey of Six New Cases, Based on New Histological and

Embryological Observations," *Am. J. Anat.*, 1925-6, **36**, 151-83, 6 text-figs., 3 pls.). Confining the study to the cat, it was found that the walls of gall-bladders and pancreatic bladders are essentially different even in their varied phases of development, distension, and degeneration. The structure of the wall of the pancreatic bladder is that of an hypertrophied pancreatic duct. C. D. F.

General.

Leucocytes and Lactation.—V. E. EMMEL, H. L. WEATHERFORD and M. H. STREICHER (*Am. J. Anat.*, 1926-7, **38**, 1-39, 4 pls.). During active nursing in the albino rat, a leucopenia of as much as one-half to two-thirds of the total leucocyte content of the circulating blood may occur. A comparison of this lactation leucopenia with that of inanition shows a parallel decrease in neutrophils and lymphocytes in the former, while in the latter only the lymphocytes decrease and the neutrophils increase. A quantitative study of leucocytic elements within the mammary gland shows an increased passage of lymphoid cells into the alveoli, and of both neutrophils and lymphoid cells within the ducts.

C. DA FANO.

Effects of X- and Radium Irradiations on Mitosis in Vitro.—(I) T. S. P. STRANGEWAYS and F. L. HOPWOOD ("The Effects of X-Rays upon Mitotic Cell Division in Tissue Cultures *in Vitro*," *Proc. Roy. Soc. Lond.*, 1926, **100**, 283-93).—(II) R. G. CANTI and M. DONALDSON ("The Effect of Radium on Mitosis *in Vitro*," *Proc. Roy. Soc. Lond.*, 1926, **100**, 413-19, 3 text-figs.).—(III) J. C. MORRIS, G. M. SCOTT and S. RUSS ("On the Effects of Beta Rays from Radium upon Division and Growth of Cancer Cells," *Proc. Roy. Soc. Lond.*, 1926, **100**, 326-35).—(I) The earliest recognisable effect of X-radiation upon growing cells is the temporary inhibition of the onset of mitotic division in the majority of those fully formed vegetative cells which are about to divide. Cells actually undergoing mitosis are unaffected by X-radiation. Vegetative cells presumably pass through a phase immediately prior to visible prophase, during which the physiological processes of the cell are particularly liable to be disturbed; if such a cell receives a dose of X-rays greater than 30e it will nevertheless enter mitosis, but the process of division will be of an abnormal type and may result in complete disruption of the cell. There is no evidence of any stimulating effect of X-rays on cell division.—(II) By means of radium radiations it is possible to bring about the cessation of mitosis in tissue cultures *in vitro*. The smaller the intensity the greater must be the time of exposure to obtain this effect. When radium is removed, mitosis generally reappears. At the commencement of irradiation not only do cells complete division when mitosis has already commenced, but some cells actually begin mitosis and go through the process of division in an apparently normal way. Radium does not produce an increase in the number of cells in mitosis.—(III) The action of β -rays of radium upon tumour cells is complicated by the various phases of cell activity, but as in the case of normal tissues cultivated *in vitro*, the cells of a rat tumour (J.R.S.) in a state of division suffered no immediate recognisable changes on exposure to large doses of β -radiation. The subsequent changes involve an absence of cells in active division, owing probably to a temporary inhibition of maturing cells entering the phase of mitosis. The final changes, which are profound enough to prevent growth of the tumour when inoculated, are interpreted by the authors as being due to the fact that eventually, after a lethal dose of radium radiation, the daughter cells are no longer capable of subsequent normal division.

C. D. F.

B. INVERTEBRATA.

Mollusca.

Gastropoda.

Notes on Aeolidians.—A. NAVILLE ("Notes sur les Eolidiens. Un Eolidien d'eau saumâtre. Origines des nématocystes. Zooxanthes et homochromie," *Rev. Suisse Zool.*, 1926, **33**, 251-89, 9 text-figs.). The fauna of the Caen canal includes several species undoubtedly imported from Northern Europe, probably by trawlers. An aeolidian, *Embletonia pallida* Cocks, occurs, feeding on *Cordylophora lacustris*, to which its eggs are also attached. The nematocysts in the cerata are identical with those of the coelenterate, which is the only possible external source of these bodies, being the only hydroid found in the canal; *E. pallida* can at no stage survive a rapid change from brackish to salt or fresh water, so cannot obtain marine coelenterates. *Aeolidiella alderi* Cocks seems to feed exclusively on the coelenterate *Heliactis bellis*, and the nematocysts found in both are identical, except that the spirocysts of the coelenterate do not occur in the cerata of the mollusc. They are not digested, and the cause of their disappearance is unknown. Similarity of internal physiological conditions in *A. alderi* and its prey is shown by the persistence of the symbiotic algae from the tissues of the coelenterate in those of the mollusc, and by the continued growth of the young nematocysts which enter the cerata. All the nematocysts in the cerata are of coelenterate origin; the absence of large nematocysts from young cerata is due to the small size of the ciliated passages leading to the latter. Both the molluscs studied confirm Wright's theory of the coelenterate origin of aeolidian nematocysts; none of the stages of nematocyst formation in the cerata, described by Labbé, have been observed.

S. D. KING.

Anatomy and Classification of Pupillidae.—C. M. STEENBERG ("Études sur l'anatomie et la systématique des maillots," 1925, 1-211, 34 pls., 50 text-figs., Reitzel, Copenhagen). Steenberg gives first a clear account of the work which has hitherto been published on this group, and then describes his own investigation which are illustrated by exceptionally good drawings. These were made possible by the use of the Greenough pattern of microscope. He also found advantage in the use of the "Bitumi" attachment to the compound microscope for examination of fine details. Serial sections were employed to confirm and elucidate structural details obtained by direct dissection. Many of the figures are drawn at a magnification of about a thousand diameters. The author remarks that Moquin-Tandon did not avail himself of the best optical apparatus in his time, whereas the contemporary American writers did. The book gives a full account of the anatomy of about two dozen species, including eleven British forms. The radulae are beautifully figured, and the book will be of the greatest value to British zoologists, even if they do not feel the cogency of the arguments which lead Steenberg to propose a considerable number of new and small families.

E. W. BOWELL.

Tentacles of *Hermisenda crassicornis*.—H. P. K. AGASSZ ("The Sensory Receptors and the Structure of the Oral Tentacles of the Nudibranchiate Mollusc *Hermisenda crassicornis* (Eschscholtz 1831), syn. *Hermisenda opalescens* (Cooper 1862-63)," *Acta Zool.*, 1925, **6**, 167-82, 23 text-figs.). Experiments show that the oral tentacles are more sensitive to food stimuli than the dorsal tentacles. They have the power of discrimination, e.g. between foods and odorous oils.

lacking in the dorsal tentacles. Accompanying this physiological difference there is a difference of structure. The oral tentacles are composed of a loosely built stroma with a central passage, not lined with epithelium, but communicating with the perivisceral cavity. Round the cavity are eight nerve columns which are extensions of the tentacular nerve arising in the anterior region of the brain. These eight columns converge distally and pass in one cord to the tip of the tentacle. Lateral branches pass from the eight cords to the periphery and end in fine fibres on the epithelium. The external covering of the tentacle is a single layer of columnar ciliated epithelium of five different types. Both longitudinal cords and their lateral branches are ganglionated. The ganglion cells are bipolar; fibrillæ are seen to pass from the cell-body on opposite sides. On either side of the nucleus is a reticular body which may be demonstrated by the gold chloride method. The subepithelial endings form the so-called taste glands; tactile and taste receptors may be distinguished.

E. W. B.

Arthropoda.

Insecta.

Tipula paludosa and Tipula oleracea.—T. A. and L. MORRISON ("Species Determination of two Common Crane-Flies, *Tipula paludosa* and *Tipula oleracea*, and Note on Mating Experiments with Tipula," *Proc. Roy. Physic. Soc. Edinburgh*, 1925-7, 21, 4-9, 2 text-figs.). The male genitalia serve to distinguish *Tipula paludosa* and *T. oleracea*. The difference in proportion of the parts is very marked and appears to be constant. Experiments show that it is probably a bar to mating between the two forms, though not absolutely preventing it. E. W. BOWELL.

Trogoderma granarium.—G. D. MORISON ("The Khapra Beetle, *Trogoderma granarium*, Everts," *Proc. Roy. Physic. Soc. Edinburgh*, 1925-7, 21, 10-13, 6 text-figs.). *Trogoderma granarium* is an Indian beetle belonging to the *Dermestidae*, introduced by commerce to England and other countries. Short details of its life history are given. The curious and characteristic hairs of the larvæ, which break up into arrow head segments, are fully illustrated; it is suggested that they are protective in function, causing gastritis in mammals which may ingest them with the grain. They do not occur on the pupa.

E. W. B.

Cytology of Hermaphroditism in *Icerya purchasi* (Coccidae).—S. HUGHES-SCHRADER (*Ztschr. f. Zellforsch. u. mikr. Anat.*, 1925, 2, 265-92, 4 pls.). The California race of *Icerya purchasi* comprises only protandric hermaphrodites and a few males. There exist no pure females. There never is any trace of parthenogenetic development of the eggs which must be fertilised by spermatozoa to initiate development. The spermatogonia occupy the central portion of the gonad, and on their ripening into spermatozoa, the organ becomes a hollow tube, from the walls of which the developing ova project on solid follicular stalks. As the ova ripen the stalk opens into the cavity of the gonad and spermatozoa pass into the space around the eggs. When maturation commences in the egg, the spermatozoa enter it in large numbers. Only one unites with the female pronucleus, and all others degenerate. Reduction is perfectly normal from four to two chromosomes in both egg and sperm. The hermaphrodites show female reactions to the rare males and differ from the latter structurally. Probably they are females in which the balance of male and female characters has been upset in the germ cells by some genetic change. Self-fertilized hermaphrodites give rise to hermaphrodites only. Cross-fertilized hermaphrodites, i.e. those which have copulated with males, may give rise to broods of hermaphrodites only, or to mixed broods containing a small

proportion of males. It is, therefore, suggested that only in the rare instances in which a male-producing spermatozoon from a pure male succeeds in fertilizing an egg in competition with the hermaphroditically produced spermatozoa, does a pure male result. There is no way to distinguish the spermatozoa of the hermaphrodite from those of the true male in fertilization. Spermatogenesis is the same in the testes of both male and hermaphrodite. The somatic and spermatogonial chromosome number is four. Two tetrads are evolved and a normal reduction takes place. The cytoplasmic division is invariably suppressed during the second maturation division, and may also sometimes be absent during the first division. Thus two kinds of spermatids are produced, binucleate and quadrinucleate whose components separate upon reaching maturity.

L. A. HARVEY.

Nematohelminthes.

Nematoda.

Contractility of the Excretory Apparatus of Nematoda.—M. AUBERTOT ("Contractilité de l'appareil excréteur chez les larves du *Rhabditis pellio* (Schn.)," *Compt. rend. Acad. d. sc.*, 1926, 182, 163-5, 1 text-fig.). In *Rhabditis pellio* larvæ of the third stage the excretory apparatus consists of two lateral tubes, from which two transverse tubes arise, meeting a single terminal tube which opens ventrally in the middle line. When larvæ are examined alive under a high magnification, the terminal tube is seen to be rhythmically contractile, attaining a maximum of two to three pulsations per second. The rhythmic contractions recorded by Maupas in the lateral tubes of *R. lucianii* are probably due to the variation of internal pressure caused by the contractions of the terminal tube, the elastic walls of the lateral tubes giving the illusion of contractility.

S. D. KING.

Platyhelminthes.

Cestoda.

Genus Dipylidium.—T. M. MILLZNER ("On the Cestode Genus *Dipylidium* from Cats and Dogs," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 17), 317-56, 7 pls.). Out of the 1,230 *Dipylidium* from 28 dogs and 30 cats, only three specimens of *D. caninum* were found, and all three came from a single dog. *D. caninum* is therefore not only the least common *Dipylidium* in dogs and cats near Oakland, California, but it is the scarcest. *D. sexcoronatum* was found in both dogs and cats. It included 0.2 p.c. of the worms from the dogs and 3 p.c. of the worms from the cats. The remaining worms belonged to five new species. One of these, *D. gracile* sp. nov., was the commonest *Dipylidium* in both dogs and cats of this vicinity. It included 74 p.c. of the worms from the dogs and 40 p.c. of the worms from the cats. *D. crassum* sp. nov. included 25 p.c. of the worms from the dogs. *D. compactum* sp. nov. was common in cats and included 40 p.c. of those from the cats. The other two species, *D. longulum* sp. nov. and *D. diffusum* sp. nov., were found in smaller numbers, 10 p.c. and 7 p.c. respectively, and only in cats.

C. DA FANO.

Gastrotricha.

More Aberrant Gastrotricha from Kiel Bay.—A. REMANE ("Neue aberrante Gastrotrichen II; *Turbanella cornuta* nov. spec. und *T. hyalina* M. Schultze 1853 (2. Beitrag zur Fauna der Kieler Bucht).," *Zool. Anz.*, 1925, 64, 309-14, 1 text-fig.). See this Journal, 1926, 46, 300. In addition to the discovery

in the sand of Labö of the exceedingly rare *Turbanella hyalina* M. Schultze, the author has found in sand in Kiel Bay a new form which he describes and figures as *T. cornuta* nov. spec. He discusses the relationship between these two forms and *Zelinkia plana* Giard, and concludes that the latter species is really a *Turbinella* and that the generic name *Zelinkia* is consequently a synonym of *Turbinella*. The genus *Turbinella* shows greater affinities with the *Macrodasypoidea* than with the *Chaetonotoidea*, and the creation of a new family for it is justified by the differences between it and *Macrodasys*.
D. BRYCE.

Some Marine Gastrotricha from Kiel Bay and Heligoland.—A. REMANE ("Marine Gastrotrichen aus der Ordnung der Chaetonotoidea (zugleich 4. Beitrag zur Fauna der Kieler Bucht).", *Zool. Anz.*, 1926, 66, 243-52, 5 text-figs.). To the three normal Gastrotricha already known to live in marine habitats the author adds six new species, which, with one exception, he has discovered in sands collected in Kiel Bay and off Heligoland. All six species belong to genera previously known from freshwater representatives, three to *Chaetonotus*, one to *Aspidiophorus* and two to *Heterolepidoderma*. Of the last-named genus, one species *H. marinum* was found in numbers on Algæ (*Furcellaria*) in the seawater aquarium of the Kiel Zoological Institute. In *Chaetonotus pleuracanthus* the usual bristles of the back are thickened into spines and limited to a single row down each side. Attention is drawn to the fact that while freshwater forms are confined to stagnating waters with a dense growth of plant-life, the marine species are almost exclusively denizens of sand.
D. B.

Coelenterata.

Nematocysts Common to Hydrozoa, Gymnoblaster and Siphonophora.—R. WEILL ("Une catégorie spéciale de nematocystes commune aux seuls Hydrides, Gymnoblaster et Siphonophores," *Compt. rend. Acad. d. sc.*, 1926, 182, 1244-7, 1 text-fig.). A special type of "revolving" nematocyst, previously described only in hydrazes, is here recorded also in the *Gymnoblaster* and *Siphonophora*. Examination of calyptoblasts and other groups has failed to demonstrate similar nematocysts among them. This seems to indicate a common parentage of the *Hydrozoa*, *Gymnoblaster* and *Siphonophora*, and a separation between the gymnoblaster and calyptoblast stems. Revolving nematocysts are characterised by the spiral rolling up of their filament when devaginated. The filament is isodiametric, wide and has few, if any, teeth. The contents stain intensely with neutral red, methylene blue, etc., but never escape from the filament, which is closed at the end. The nematocysts of *Hydrozoa* and *Gymnoblaster* resemble one another closely, while those of *Siphonophora* show minor differences.
S. D. KING.

Rotatoria.

The Rotifer in the Laboratory and its Food.—J. E. FINNESINGER ("Effect of certain Chemical and Physical Agents on Fecundity and Length of Life, and their Inheritance in a Rotifer, *Lecane inermis* (Bryce).", *Journ. Exp. Zool.*, 1926, 44, 63-94). The subjects of the experiments detailed were descendants of a single example of *Lecane inermis* taken from a mass culture. The species has not hitherto been used for culture investigations. It is parthenogenetic and has an average duration of life of about eight days. It lays about 15 eggs having a high percentage of viability. The eggs hatch in from 18 to 24 hours, and the young begin to produce eggs from 24 to 36 hours after hatching. Twenty individuals were employed in each experiment. The animals were reared on a 0.1 p.c. of a malted milk solution (0.5 gram of Horlick's malted milk dissolved in 50 c.c. of

boiling water), a food already used by Miss Noyes in experiments on another Rotifer, *Proales felis*. To 10 c.c. of this solution 90 c.c. of spring water was added, heated to boiling, and filtered. This culture fluid was prepared daily. Mass cultures and individuals were reared in one concavity of two-cavities depression slides (control animals being placed in the second concavity), which were kept on glass supports over 150 c.c. distilled water in closed Stender dishes. The chemicals whose influence was tested were FeSO_4 , FeCl_3 , HCl and NaSiO_3 in various greatly diluted concentrations. The effects of ethyl alcohol in several strengths were also tested. Some experiments were carried on in the variable temperature of the room, in others the cultures were kept at a uniform temperature. When the rotifers were reared on the malted milk solution none of the chemicals produced any significant increase over the normal in the production of eggs; yet when, as in the control cultures, they were kept in spring water without food, there was a significant increase in productivity if ferric sulphate or hydrochloric acid were the chemicals employed.

D. BRYCE.

The Development of Fertilized Eggs of Rotifers.—J. C. LITE and D. D. WHITNEY ("The Rôle of Aeration in the Hatching of Fertilized Eggs of Rotifers," *Journ. Exp. Zool.*, 1925-6, 43, 1-9, 2 text-figs.). The fertilized eggs of rotifers, frequently called resting eggs, because their hatching is usually considerably delayed, are mostly provided with a dense inner envelope. But individual fertilized females have been observed to produce eggs lacking this thick envelope, and these eggs hatched soon after being laid. To ascertain what conditions were favourable for accelerating or retarding the development and hatching of the fertilized egg, a series of experiments was carried out upon many thousands of fertilized eggs of *Brachionus bakeri* and a much smaller number of those of *Asplanchna intermedia*. The results obtained are summarised in the following conclusions: (1) Newly produced fertilized eggs of the rotifer *Brachionus bakeri* will develop normally and quickly in aerated water at room temperature. (2) The young rotifers are unable to break through the egg membranes because of the firmness of the new membranes. (3) Keeping the newly laid fertilized eggs of *Brachionus* and *Asplanchna* a few days in sealed containers amid a mass of decomposing organic material weakens the covering membranes of the eggs so that the young rotifers can readily break through them. (4) Such eggs develop and hatch slowly or quickly according to the amount of aeration in the culture water. (5) Fertilized eggs of *Asplanchna* normally have a thick inner covering membrane which probably shuts off the oxygen supply and causes the development of the young rotifers to cease. The abnormal fertilized eggs which lack this thick membrane may produce the young females that may hatch inside the body of the mother as do the parthenogenetic eggs or, if laid, hatch soon afterwards.

D. B.

Plankton Research at Helsingfors.—ILMARI VÄLIKANGAS ("Planktologische Untersuchungen im Hafengebiet von Helsingfors. I. Über das Plankton insbesondere das Netz-zooplankton des Sommerhalbjahres," *Acta Zool. Fenn.*, 1926, 1, 1-298, 28 text-figs., 17 tables, 6 pls.). Herein are comprehensive and exhaustive accounts of a series of Plankton collections made during the months April to October of 1919 in the waters within the boundaries of the port of Helsingfors, in connection with a Special Survey of these waters with regard to their normal condition and the amount of sewage pollution. The outstanding geographical position of the city and the sheltering proximity of numerous islands give a very varied character to these waters and, complicated by the entrance to the east of the city of a considerable river, result in a diversified range of salinity

in the various bays and in the channels between the islands. These conditions are reflected in the long list of plankton organisms which have been collected. On the basis of the ratio of saline constituents in the water at the respective stations where the collections were made, the author, employing the terms used by Redeker with reference to the chlorine content of brackish waters, designates the organisms as *oligohalin* when the salinity which appeared to most favour their vigorous growth did not exceed 2.00 per mill., and *mesohalin* when it exceeded that proportion, but did not exceed 16.50 per mill. The term *polyhalin* for waters exceeding 16.50 per mill. salinity was not applicable to the waters surveyed. He considers that the term "brackish water" properly applies to waters within the mesohalin range of salinity, and he subdivides such waters into *meio-* or β -*mesohalin* waters with a salt content of from 2.00 per mill. to 8.00 per mill. and *pleio-* or α -*mesohalin* waters with a salt content of from 8.00 per mill. to 16.50 per mill. Such organisms as flourish best in these respective ranges of salinity he designates by the same terms, and such as flourish apparently through the whole mesohalin range he calls *euryhalin*. The waters affected by sewage pollution are dealt with in similar fashion.

Among the many organisms present in the collections the author has identified 33 species of Rotatoria, while three others are noted under generic names only. The great majority are freshwater forms which have been able to live in the very moderate salinity of the waters of the region. The most noteworthy of these are *Floscularia pelagica*, *Asplanchna priodonta* and *A. Brightwelli*, *Triarthra brachiata* and *Gastropus stylifer*. Among those which are already known as inhabitants of brackish water are prominent the four species of *Synchaeta baltica*, *littoralis*, *fennica* and *monopus*, and *Anuraca eichwaldi*. The *Synchaetae* and especially *S. littoralis*, were dominant in many collections. On one occasion the species last named was represented at the rate of 2,460 examples per litre, but the more usual number was under 200 individuals per litre.

D. B.

Protozoa.

Anomalous Forms of *Plasmodium vivax*.—G. DELAMARE and S. DJÉMIL ("Formes anormales de *Plasmodium vivax*," *Compt. rend. Acad. d. sc.*, 1926, 182, 178-80). Various abnormal forms of *P. vivax*, often resembling the anomalous forms considered to be characteristic of *P. praecox*, are described. The nuclei vary in number from 0 to 5, and are often different in shape and structure even in the same plasmodium; they may be endoplasmic or ectoplasmic, and are sometimes almost isolated from the body in slender pseudopodia. The shape of the body also varies greatly, and the vacuole may disappear, or communicate with the exterior, or several vacuoles may be present.

S. D. KING.

Structure of Infusoria of the Cast Skin of Crustacea.—E. CHATTON and A. LWOFF ("La structure et le cycle évolutif des infusoires des mues de Crustacés et leur place parmi les Foettingeriidae," *Compt. rend. Acad. d. sc.*, 1926, 182, 100-2). The *Polyspora* and *Gymnodinioides* of *Eupagurus prideauxii* are found on the gills as cysts containing pigmented masses which are reserve materials comparable to yolk. These masses are slowly absorbed with precipitation of the carotinoid pigment which impregnates them. The cysts open at ecdysis, the parasites inserting themselves between the two carapaces, where they swell rapidly, absorbing nourishment through a small buccal opening. The substances absorbed collect to a vitelloid mass, which may be pigmented. This is the chromatophore of Minkiewicz. A metamorphosis occurs during this process, and the regular meridional bands of cilia become twisted. After twelve hours the ciliates leave the cast skin and swim

round it; another metamorphosis follows, involving partial detorsion and fragmentation of the central vitelloid mass. Multiplication and conjugation have been adequately described by Minkiewicz. The young fix themselves to the gills of *E. prideauxii* and are filled with platelets which are pigmented like the original vitelloid mass from which they arose. The life history as above elucidated shows a remarkable resemblance to that of *Spirophrya*, and these two genera should be included in the family *Foettingeriidae*. S. D. K.

Plistophora bufonis.—E. GUYENOT and K. PONSE ("Une Microsporidie, *Plistophora bufonis*, parasite de l'organe de Bidder du Crapaud," *Rev. Suisse Zool.*, 1926, 33, 213-50, 6 text-figs., 1 pl.). *Plistophora bufonis* n. sp. develops inside the oocytes of the Bidder's organ of *Bufo vulgaris*, which organ it gradually destroys. The parasite has two types of developmental cycle, comparable to those described by Guyenot and Naville (1922) in *P. (Glugea) danilewskyi*. Stages of both cycles may occur in a single oocyte. The cycle leading to the formation of macrospores includes a schizogony in which the elements are large with vacuolated cytoplasm and voluminous nuclei, and a sporogony in which the sporonts, by multiple division, form multinucleate plasmodia; these break up to a fairly definite number (4, 8, 16) of sporoblasts, giving each a large spore. In the cycle leading to the production of microspores, the vegetative forms engaged in schizogony are small, multinucleate and sometimes filamentous. The sporonts form plasmodia, in which their nuclei multiply by typical mitoses, almost always showing three chromatic granules. Inside these plasmodia about 32 to 64 little sporoblasts form, giving each a microspore. The parasite can also develop in the follicular cells which penetrate the oocytes; schizogony and especially sporogony stages are found in their cytoplasm or nuclei. These parasitised cells are also found in the stroma, and probably help to distribute the parasite through the organ. It is probable that *Bertramia bufonis*, a parasite of the Bidder's organ of another species, and which King has classified among the *Haplosporidia*, is identical with *P. bufonis*. S. D. K.

Leishmania brasiliensis.—D. CAUSEY ("Mitochondria in *Leishmania brasiliensis*, Vianna 1911," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 1), 19-28, 1 pl.). In *Leishmania brasiliensis* there are usually 8 mitochondria, indicating a constant ratio between the volume of the cytoplasm and the number of mitochondria. As in *E. gingivalis*, spherical mitochondria are correlated with catabolic, rod-shaped mitochondria with anabolic activities, the former being found in the ordinary phases, the latter in dividing forms, in which anabolic activities are indicated by rapid growth. The author believes the parabasal body to be a derivative of the mitochondria owing to the similarity of its staining reactions. In *Herpetomonas* forms two of the mitochondria are transformed into fat bodies, and at division a similar transformation of all the mitochondria occurs; those found in the daughter cells being apparently formed *de novo*. S. D. K.

The Family of Sarcosporidia.—P. VUILLEMIN ("La famille des Sarcosporidies. Son étendue. Ses affinités," *Compt. rend. Acad. d. sc.*, 1926, 182, 911-13). The author supports the classification of the Sarcosporidia (including *Rhinosporidium*) as a family of the Sporozoa. Its exclusion from that order is due to a misconception of the place in the life history occupied by the observed stages, which have been called sporogony, while in reality they correspond to the schizogony of *Coccidia* and *Hamosporidia*. True sporogony has not yet been observed, and probably occurs after fertilization either in the intestine or in the faeces of the host, as in *Coccidia*. S. D. K.

Trichoduboscqia epeori n. g., n. sp.—L. LEGER ("Une microsporidie nouvelle à sporontes épineux," *Compt. rend. Acad. d. sc.*, 1926, **182**, 727–9, 1 text-fig.). In *Trichoduboscqia epeori*, n. sp., the sporonts, unlike those of all known microsporidia, are complicated by the presence of four long spines, hollow outgrowths of their outer layer, which are present even before the spores are properly differentiated in the body of the sporont. Sixteen pyriform spores, each with a nucleus at the broad end, are typically present; two stainable spots at the thin end may represent parietal nuclei; the polar capsule has not been demonstrated, and there is no vacuole. Some sporonts may contain only eight or twelve spores, and sometimes only two or three spines are present. S. D. K.

Cycle of *Pleistophora periplanetae*.—J. GEORGEVITCH ("Sur le cycle évolutif de *Pleistophora periplaneta*," *Compt. rend. Acad. d. sc.*, 1926, **182**, 102–4). The pansporoblasts of *P. periplanetae* are uninucleate, 1.5 to 2.5 μ in diameter, with homogeneous cytoplasm and a central nucleus containing a karyosome. They divide repeatedly, and after separation may divide again into uninucleate elements, or grow into plasmodia, which may or may not bud or divide. No breaking down of the nuclei to chromidia occurs at any stage. The endoplasm of the plasmodium contains granules, sometimes larger than the nuclei. These are cytoplasmic structures, not nuclear. A single pansporoblast may enter on sporogony by division of its nucleus to six, one vegetative, two parietal, one capsulogenous, and two gametes. The pansporoblast may first multiply its nuclei, then enter on polysporous sporogony, as in coccomyxa. The sexual process must be an autogamy occurring near the end of sporulation. Owing to the undoubted affinities of this genus with the *Myxosporidia* and *Microsporidia*, the author places it in the order *Crypturosporidia*, between these two. S. D. K.

Intra-Vitam Staining and Sexualisation in Gregarines.—P. JOYET-LAVERGNE ("Les colorations vitales des Grégarines et la sexualisation du cytoplasme," *Compt. rend. Acad. d. sc.*, 1926, **182**, 1295–7). Individuals belonging to the species *Gregarina polymorpha*, *G. cuneata* or *Steinina ovalis* stain differently with Nile blue, cresyl blue, methylene blue and dahlia when conjugating. As a rule the primate (female) stains more intensely than the satellite (male). But if the above stains are reduced before use, the staining reaction is reversed. Neutral red does not show any difference between the conjugants owing to its affinity for the Golgi bodies, while the other stains enter the cytoplasm as leucoderivatives, and the cell provided with a more reducing cytoplasm stains sooner and more intensely. S. D. K.

Ceratium Hirundinella.—R. P. HALL ("Mitosis in *Ceratium Hirundinella* with Notes on Nuclear Phenomena in Encysted Forms and the Question of Sexual Reproduction," *Univ. Calif. Publ. Zool.*, 1925–6, **28** (No. 3), 29–64, 5 pls., 5 text-figs.). A typical neuromotor system is present in *Ceratium hirundinella*, consisting of two flagella and their blepharoplasts, from each of which a flagellar rhizoplast leads to an extranuclear centrosome near the nucleus. After division a paradesmose temporarily connects the daughter centrosomes, as in *Ocyrrhis marina*. True mitosis, resembling that of *Noctiluca miliaris* (Calkins, 1899) occurs; the chromosomes split longitudinally in the prophase, remaining connected at one end only; the free ends move apart till, in the metaphase, each pair of daughter chromosomes looks like a single long element; the apparent transverse division (Entz) at this stage is a true division of the daughter chromosomes. The nuclei of encysted forms have chromosomes similar to those of vegetative stages, but apparently more numerous, and with smaller chromomeres. Karyosomes are

present in both flagellate and encysted forms. Binucleate cysts are described, possibly representing the products of conjugation, in which each conjugant has contributed a nucleus.

S. D. K.

Proboscidiella multinucleata g. n., sp. n.—C. A. KOFOID and O. SWEZY ("On *Proboscidiella multinucleata* gen. nov., sp. nov., from *Planocryptotermes* Nocens from the Philippine Islands, a Multinucleate Flagellate with a Remarkable Organ of Attachment," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 16), 301-16, 4 text-figs., 2 pls.). *Proboscidiella multinucleata* occurs in the anterior part of the intestine of *Planocryptotermes nocens*, attached to the wall by its proboscis. It is a multinucleate polymastigate flagellate with one to thirty-seven cells, with their nuclei grouped anteriorly at one level. The nucleus has a posteriorly located karyosome in a clear halo, and a well-defined chromatin net. The neuromotor system consists of an anterior centrosome on the nuclear membrane, rhizoplast, bar-shaped blepharoplast, with a primary granule giving rise to the primary anterior flagellum, axostyle, and an anterior axostylar process, and a secondary or distal granule, giving rise to the two secondary flagella. Each somatella, regardless of the number of nuclei, has a single extensile and retractile proboscis, to whose mobile tip all the single anterior axostyles extend. Siderophile tubular structures, possibly vestigial sleeves, such as occur around the axostyle of *Oxymonas*, are found in some individuals. Wood chips are ingested by the amoeboid action of the posterior end. Binary fission of the body occurs with equal or unequal distribution of the constituent nuclei. Supernumerary neuromotor systems have been observed in mononucleate individuals. The evolutionary derivation of *Proboscidiella* from an *Oxymonas*-like ancestor is suggested by both morphology and behaviour.

C. DA FANO.

On *Oxymonas* from *Kalotermes*.—C. A. KOFOID and O. SWEZY ("On *Oxymonas*, a Flagellate with an Extensile and Retractable Proboscis from *Kalotermes* from British Guiana," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 15), 285-300, 5 text-figs., 1 pl.). *Oxymonas projector* from the digestive tract of *Kalotermes* (*Glyptotermes*) *perparvum* Emer., from Kartabo, British Guiana, is a uninucleate polymastigote flagellate derived from the triflagellate ancestor by the duplication of the neuromotor system (except the axostyle) without nuclear duplication. Each unit of the duplicated system consists of centrosome, rhizoplast, blepharoplast (united with its mate by a blepharoplast semicircle), and three equal flagella. There is a single axial rhizoplast which extends anteriorly into the extensile and retractile proboscis, operated by cytosomal protraction and retractor fibrils attached to the axostyle. In the genus *Oxymonas* as originally described by JANICKI (1915) the flagella were overlooked entirely, and the proboscis sleeve was not found. The description of the genus is accordingly emended here to include these essential features. The nucleus has a posteriorly excentric karyosome with surrounding clear halo, in one side of which an endosome is found. This flagellate presents the first step in the progressive independence of the neuromotor complex from the nucleus. It passes in this genus from a unitary to a partial binary status. A later stage in this process is seen in *Stephanonympha*, in which the somatella is multinucleate, but there is a great excess of neuromotor units in the spiral series. Two other new species, *O. pediculosa* from *Kalotermes nigriceps* Emer., and *O. gracilis* from *K. magninotus* Emer., have similar structures, but the proboscis and sleeve are less highly evolved.

C. D. F.

Studies on *Endamoeba gingivalis*.—H. J. CHURCH ("Studies on the Ingestion of Leucocytes and on Mitosis in *Endamoeba gingivalis*," *Univ. Calif.*

Publ. Zool., 1925-6, 28 (No. 14), 251-84, 9 text-figs., 5 pls.). The food of *Endamoeba gingivalis* consists of "salivary corpuscles," i.e. disintegrating leucocytes as well as of whole polymorpha. Ingested leucocytes are contained in vacuoles in which they are surrounded by a clear fluid. Digestion is rapid, and the leucocytes become transformed into spherical masses which are then indistinguishable from the salivary corpuscles. Viscous food inclusions of leucocytic origin may be expelled in part from one or two vacuoles, and the free ends of the extrusions ingested by other amoebæ. In the first mitotic figures available, the karyosome as such has disappeared. Six chromosomes appear as small granules on the spoke radii. These increase in size and migrate toward the centre of the nucleus, where they appear as a cluster of minute, blunt rods. They seem to derive their chromatin from the peripheral chromatin and from the granular halo, which simultaneously disappear. The beads of peripheral chromatin remaining after chromosome formation become concentrated in a single peripheral mass, carrying with them the spoke radii, so that these converge into the mass connecting the chromosomes with it. The chromosomes split longitudinally, but not synchronously. The peripheral mass or centrosome divides, and the daughter centrosomes migrate to positions diametrically opposed to each other. As they do so they draw out between them a fine strand or intradesmose, which lies in a meridional position inside the nuclear membrane. Stretched between the poles along their axis is the spindle, bearing the clustered chromosomes in an equatorial position. The chromosomes separate and migrate toward their respective poles. One pair of chromosomes is smaller than the others. As the chromosomes approach the poles, the nucleus constricts in the equatorial plane and divides to form two daughter nuclei. The polar mass in each breaks up, and its chromatin becomes redistributed on the inner surface of the nuclear membrane. The chromosomes disappear, probably contributing to the new peripheral chromatin. The spoke radii reappear. The origin of the new karyosome is not known. The amoeba elongates and constricts in the equator, dividing to form two daughter amoebæ.

C. D. F.

Oxyphysis oxytoxoides.—C. A. KOFROID ("On *Oxyphysis oxytoxoides* gen. nov., sp. nov. A Dinophysoid Dinoflagellate Convergent toward the Peridinioid Type," *Univ. Calif. Publ. Zool.*, 1925-6, 28 (No. 10), 203-16, 1 pl.). A new genus and species of *Dinophysoidæ*, *Oxyphysis oxytoxoides* is described from the marine plankton at Loring, Alaska, and in the San Pedro Channel, off the Californian Coast. The genus has the plate structure of the *Dinophysoidæ*, and is related to the genera *Dinophysis* and *Phalacroma* in that tribe. It has the facies, size, shape, proportions and degree of development of the organs of flotation of the genus *Oxytoxum* of the tribe *Peridinioidæ*. It resembles certain species of *Oxytoxum* in a considerable number of details of structure.

C. D. F.

A New Cretaceous Uvigerina from Louisiana.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 1 figs. 1 a-c on pl. iv.). Figures and describes *Uvigerina seligi* n. sp. from the Upper Cretaceous Arkadelphia Clay of Louisiana. The first Cretaceous record for the genus in America, and regarded by the author as probably the ancestral form of those species which occur in the Eocene and Oligocene of the Coastal Plain of the United States and Mexico.

A. EARLAND.

Three New Species of Siphogenerina from the Miocene of California.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 2-3, 3 figs. on pl. iv.). Figures and describes three new species from the Monterey Shales (Miocene)

of San Luis Obispo County, California. The author suggests that the three species of *Sagrina* figured and described from the same material in 1905 by R. M. Bagg (Bulletin 268, U.S. Geological Survey), are microspheric and megalospheric forms of one species which should be known as *Siphogenerina branneri* (Bagg). A. E.

New Foraminifera from the Upper Eocene of Mexico.—J. A. CUSHMAN (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 4-8, 1 pl.). Figures and describes a new genus *Rotaliatina* and six other new species from the Alazan and Tantoyuca formations in Mexico. A. E.

A New *Uvigerina* from the Vienna Basin.—J. A. CUSHMAN (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 10, 3 figs. on pl. iv.). Species of *Uvigerina* which are truly compressed are very rare. *U. parkeri* Karrer, from the Miocene of the Vienna Basin is such. The author describes and figures a somewhat similar compressed species under the name of *U. compressa*. It is also from the Vienna Basin, and is more ornate than Karrer's form. A. E.

Some Later Tertiary Cassidulinas of California.—J. A. CUSHMAN and D. D. HUGHES (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 11-16, 1 pl.). The genus *Cassidulina* is abundantly represented in the Pliocene of Timm's Point, California. The material is rich in Foraminifera, but 75 p.c. of the specimens belong to this genus. In the Pleistocene of Lomita Quarry, *Globigerina* becomes the dominant genus, but *Cassidulina* still constitutes 5 p.c. of the material. The dominant species differ in the two deposits. There are no specimens which can be definitely referred to *Cassidulina laevigata* d'Orbigny. Descriptions and figures of six new species and varieties. A. E.

Some New Foraminifera from the Velasco Shale of Mexico.—J. A. CUSHMAN (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 18-22, 1 pl.). The Velasco shale, which is Upper Cretaceous, is very rich in Foraminifera, and many species are identical with species from the Uppermost Cretaceous strata of Europe. But there are a number of species which appear to be distinct, and seven of these are described and figured in this paper. A. E.

Apertural Characters in *Cristellaria* with descriptions of a New Species.—J. A. CUSHMAN (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 24-26, 8 figs. on pl. iv.). Describes a new species of *Cristellaria beali* from the Miocene Monterey Shales of California allied to *C. arcuata* d'Orbigny, but possessing a secondary chamberlet into which the typical radiate aperture opens, which the author terms the apertural chamberlet. The septal wall of this chamberlet is much thinner than the wall of the test, and it is pierced with a circular aperture connecting it with the secondary chamber. A similar structure has been observed in other species of the genus, and the author thinks that the formation of the apertural chamberlet may be a provision for the enlargement of the radiate aperture by resorption, without weakening the general wall of the test. A. E.

Some Textulariidae from the Miocene of California.—J. A. CUSHMAN (Contr. Cushman Lab. Foraminif. Res., 1925-6, 1, 29-34, 1 pl.). The author considers that a close study of some of the *Textulariidae* from the Miocene Monterey shales of San Luis Obispo County, California, in the light of stratigraphic data, makes distinct many closely allied species. Thirteen so-called new species and varieties are described, which appear to be no more than ecological variations. A. E.

Siphogenerina hughesi, a New Species from California.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 36, 2 figs. on pl. vii.). Description of a new species from Miocene Monterey Shale, characterised by its smooth surface, a feature which the author regards as very rare in the genus. A. E.

New Species of Cassidulina from the Pacific.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 36-8, 8 figs. on pl. vii.). A study of recent Pacific material shows that the *Cassidulinae* are much more ornate and bizarre than those of any other region. Two new species are described and figured, one of which *C. elegantissima* is extremely distinctive. It has a surface covered with irregular polygonal reticulations, each chamber being furnished with a stout marginal spine. A. E.

Recent Foraminifera from British Columbia.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 38-45, 2 pls.). Very little is known of the Foraminifera of the American shores of the Pacific, which is one of the least explored regions of the world so far as this order is concerned. The author has examined two small collections from Virago Sound and Queen Charlotte Sound, depths ranging from 8-25 fathoms, and describes the species of greatest interest, including eleven new forms, in what appears to be a preliminary paper. He states that the fauna has a very definite relationship with the late tertiary of California, as well as with the recent fauna of South America. Three of the species described by d'Orbigny in 1839, from the West Coast of South America, are typical in the Columbian material. One of the new species, *Discorbis ornaticissima*, occurs abundantly in the plastic condition. A. E.

Foraminifera as an Original Source of Petroleum.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 48). Foraminifera have been suggested as one of the sources of petroleum, largely because they occur in oil-bearing strata in various parts of the world. The author having observed oil globules in the living protoplasm of many species, and having regard to the fact that Foraminifera are often associated with commensal algæ, is not inclined to disregard the possibility of the accumulated oils becoming transposed into petroleum, but he states his case very moderately, and suggests further study of the oil contents of living forms. A. E.

Notes on the Genus Cassidulina.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 51-60, 2 pls.). A very useful compendium, purporting to give the original reference and a copy of the type figure of all the species of the genus. The original locality of the type is also given. The species are grouped by geological periods, and the recent species by regions. The figures, although merely outline drawings, are very clear and good, and the list appears to be complete with the exception of *Cassidulina nitidula* (Chaster), which has been omitted. A. E.

Mexican Species of Marginulina.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 61-2, 6 figs. on pl. x.). Descriptions of three species of *Marginulina* from the Oligocene and Eocene of the Coastal Plain of Mexico. They are of interest as distinctive of rather definite horizons, and two of them are new species. A. E.

Notes on the Genus Tritaxilina.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 62-5, 1 fig. on pl. x.). Cushman created the genus in 1911 for the species from the Philippines described by Brady under the name

Tritaxia caperata. Later, in 1922, he described a recent form from the Caribbean. He now describes a third form from the Eocene of Vera Cruz, Mexico, which is intermediate between the other two and may be the ancestral type. A. E.

Eocene Foraminifera from the Cocoa Sand of Alabama.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 65-9, 9 figs. on pl. x.). The Cocoa Sand is of Upper Eocene age and contains abundant Foraminifera, some of which are widely distributed in the Upper Eocene of the general Gulf Coastal Plain. Some of the species are closely related to, or identical with, those of the Upper Eocene of Europe. Five new species and varieties are described. A. E.

The Genus *Chilostomella* and Related Genera.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 73-80, 1 pl.). The author is of opinion, after a study of recorded figures and descriptions, that, instead of there being but one species, *C. ovoides* Reuss, including both fossil and recent forms, there are probably two genera with several distinct species. He considers that the Cretaceous and some of the Eocene forms are distinguishable from the recent and most of the tertiary forms in the apertural characters. Two new genera, *Chilostomelloides* and *Chilostomellina*, and three new species are created. A. E.

Some Fossil Bolivinas from Mexico.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 81-5, 1 pl.). There are abundant Foraminifera in some of the Alazan clays of Mexico, especially in those of very fine texture. They include several species and varieties of *Bolivina*, which have a very definite vertical distribution, and seem to differ from any described forms. Five new species and varieties are figured and described. A. E.

Trifarina in the American Eocene and Elsewhere.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 86-7). Describes, but does not figure, a new variety from Upper Eocene, Jackson, Mississippi, and discourses on the distribution of the genus in the Atlantic and Pacific. A. E.

A Peculiar Frondicularia from Mexico and Trinidad.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 88-9, 3 figs. on pl. xiii.). Figures and describes a new species, *F. mexicana*, from the Alazan clays of the Coastal Plain of Mexico. It occurs at several stations, also in Trinidad, and is very constant in its characters. Its relationships are Indo-Pacific, and it is compared with other species. A. E.

Miocene Species of *Nonionina* from California.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1925-6, 1, 89-92, 1 pl.). There are in certain zones of the Monterey Shale enormous numbers of several species of *Nonionina*. Three of them are closely allied, but have distinctive characters and very definite stratigraphic ranges. A fourth species having a somewhat wider range is *Nonionina auris* (d'Orbigny). Figures and descriptions of three new species and of *N. auris*. A. E.

***Eouvigerina*, a New Genus from the Cretaceous.**—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 3-6, 6 figs. on pl. I). A new genus is formed for the reception of two new species from the Upper Cretaceous of Texas. They are described as closely related to *Sagrina cretacea* Heron Allen and Earland, and *S. aspera* Marsson, both from the Upper Cretaceous of Europe, which the author regards as proper to his new genus. According to the author *Eouvigerina* may probably be the ancestral type of *Uvigerina*, and he discourses at some length on the problematical relationships with other genera. A. E.

The Genus *Lamarckina* and its American species.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 7–13, 12 figs. on pls. 1 and 3). The author revives the generic name *Lamarckina*, which was proposed by Berthelin in 1881 for Karrer's species *Pulvinulina erinacea* from the Miocene of Hungary. The name has not been used by later authors. A number of new American species ranging from Cretaceous to Lower Oligocene are figured and described, and several recognised species of *Pulvinulina*, recent and fossil, are transferred to *Lamarckina*.
A. E.

***Siphogenerina plummeri*, a Species from the Upper Cretaceous of Texas.**—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 15, 3 figs. on pl. 1). The genus *Siphogenerina* is stated to be decidedly rare in the Cretaceous, though known in many formations from the Lower Eocene upwards. It is exceptionally well developed in the Miocene of the Pacific Coast, also in Florida and other localities. It is now found mainly in the tropical Atlantic and Indo-Pacific regions. *S. plummeri* is described as very small but distinctive, and as occurring in considerable numbers in two localities.
A. E.

Some Foraminifera from the Mendez Shale of Eastern Mexico.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 16–24, 23 figs. on pls. 2 and 3). Describes and figures a number of striking forms from these Shales, several of which are described as new. The shales have a rich fauna, many species being identical or closely related to species from the Upper Cretaceous of Texas and Europe.
A. E.

New Foraminifera from the Upper Eocene.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 29–36, pls. 4, 5 and part of 6). Figures and descriptions of fifteen new species and varieties from the South Eastern Coastal Plain deposits of the United States. With the exception of a *Polymorphina* all belong to the family *Textulariidae*. The author remarks on the differences of the faunas of these Upper Eocene beds, the Florida limestones containing shallow water types, while the Mississippi and Alabama deposits are deeper water sediments.
A. E.

New Plectofrondicularia from Pliocene of California.—J. A. CUSHMAN and R. E. STEWART (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 39, 3 figs. on pl. 6). A new species of this sub-genus, characterised by its tapering contour and regularly increasing chambers. No perfect specimens have been obtained.
A. E.

Some Pliocene Bolivinas from California.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 40–6, 1 pl.). The genus *Bolivina* is especially abundant in the Fernando series of the Pliocene of California, and the species show a rapid evolution of form which enables them to be used as zone fossils in the study of cores from well borings. They resemble species living in identical conditions on the Western Coasts of America. Five new species and three new varieties are described and figured.
A. E.

Foraminifera of the Typical Monterey of California.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 53–66, 3 pls.). The "typical Monterey" is a Miocene deposit defined as the "upper portion of the section known as Monterey below the Santa Margarita sandstone." Foraminifera are very abundant and include about 60 species and varieties, many of which have a very limited range and do not occur in the lower Monterey beds. The fauna has a

close resemblance to the living fauna of the adjacent coast. Four new genera *Valentinaria*, *Pulvinulinella*, *Baggina*, and *Nonionella*, and one new sub-genus *Uvigerinella*, and sixteen new species and varieties are figured and described.

A. E.

The Generic Position of Pulvinulina favus H.B. Brady.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 70-1). Brady's species is common in some parts of the Pacific, and is characterised by a thick exogenous deposit of honeycomb ornament. Cushman claims that sections disclose a Cassiduline structure, and that it is closely allied to *Cassidulina decorata* Sidebottom, and *elegantissima* Cushman, both of which are known only from the Pacific and possess somewhat similar surface ornament. No figure illustrating the newly discovered structure is published.

A. E.

Some Phases of Correlation by means of the Foraminifera.—J. A. CUSHMAN (*Contr. Cushman Lab. Foraminif. Res.*, 1926, 2, 71-4). The author considers that Foraminifera are excellent guides to the general age of a deposit if one is sufficiently familiar with faunas. The presence of certain genera will in any part of the world give the general age of a deposit up to Cretaceous times. But with the Tertiary the possibility of correlation is no longer so definite, as the genera have become more specialised as to habitat, and the contrast between faunas of closely adjacent areas and similar age is frequently strongly marked. This differentiation becomes progressively increased in the later Tertiaries, in which the Foraminifera have come to be very specialised as to habitat. Thus the Miocene and Pliocene deposits of the Eastern States have very little in common with those of similar age on the Pacific Coast, though each has much resemblance to the fauna existing on the adjacent coasts to-day.

A. E.

New Zealand Fossil Foraminifera.—F. CHAPMAN ("The Cretaceous and Tertiary Foraminifera of New Zealand, with an Appendix on the Ostracoda," *Paleont. Bull. No. 11, Geol. Surv. Branch Dep. Mines, Wellington*, 1926, 1-119, 22 pls.). The author and his wife have been engaged for many years on the examination of fossil material from a long series of localities, ranging from Cretaceous to Oligocene, and his monograph will be of great and lasting value to students everywhere. There is an analysis of the already published literature on New Zealand fossil Foraminifera, special attention being devoted to the separate papers published in 1864 by Karrer and Stache in the report of the "Novara" Expedition. The first five plates are devoted to a reproduction of their illustrations, and the author in his introduction suggests fresh determinations for their species where necessary. The remaining plates are process reproductions of Chapman's own drawings and, good as the majority are, it is disappointing not to contrast them detrimentally with the beautiful figures of the earlier authors, which the reviewer thinks represented almost the high-water mark of illustration as applied to the Foraminifera. The total number of species of Foraminifera described in the monograph is 277, of which 29 are Cretaceous and 266 Cainozoic. 11 of the Cretaceous species do not extend to the later formations, but 14 of them are living to-day. There are 11 new species and varieties. The Ostracoda number 28 species comprised in 11 genera. 5 new species are described and figured.

A. E.

Foraminifera of the Genera Siphogenerina and Pavonina.—J. A. CUSHMAN (*Proc. U.S. National Museum*, No. 2597, 1926, 67, Art. 25, 1-24, 6 pls.). The author, referring to the hesitation with which Schrammberger's genus *Siphogenerina* was accepted, states that he has examined the type material and found it to be distinct from *Pavonina*.

generina (1883) has been accepted, expresses his preference for it instead of *Sagrina* d'Orbigny (1839), and proceeds to transfer most of the species attributed by various authors to *Sagrina* to Schlumberger's genus. One new species and three new varieties are created. There is a full description of all the species regarded by the author as proper to *Siphogenerina* with excellent figures. *Pavonina*, created by d'Orbigny in 1826 for the type-species *flabelliformis*, which was illustrated by a figure and subsequently also by a model, remained a somewhat mysterious object for over fifty years, until Brady rediscovered the species at the Seychelles and in the Challenger material, and was able to ascertain its textularian structure and affinities. Since then the genus has been found in many localities, recent and fossil. Cushman considers the American forms to be distinct from d'Orbigny's Old-World species. Full descriptions and figures of the four distinct species into which the author divides the records are given, two being recent and two fossil. One of the latter is a new species.

A. E.

Recent Foraminifera from Porto Rico.—J. A. CUSHMAN (*Papers Dep. Mar. Biol. Carnegie Inst. Washington*, 1926, 23, 75–84, 1 pl.). The only previous records from Porto Rico are those of J. M. Flint, who listed a few species from comparatively shallow gatherings in outside waters. Cushman's collections were made in very shallow water inside the harbour, and represent a rather starved but typical West Indian Fauna. One new variety is created for a pauperate form of *Rotalia beccarii* (Linné), abundant in the gatherings.

A. E.

Foraminifera of the Cretaceous of Central Texas.—DOROTHY O. CARSEY (*University of Texas Bull.*, No. 2612, 1926, 1–56, 8 pls.). The author states that the study of hundreds of samples of rock has convinced her that not only do distinct species of Foraminifera mark the greater geological periods, but that many species are restricted to the subdivisions of these periods, and that some species are even restricted to horizons in these formations. The paper is designed to serve as a practical working basis for the study of the Cretaceous sediments of Central Texas, and includes analyses of the various formations of the Gulf and Comanchean series, with lists of their characteristic Foraminifera. Over 30 new species and varieties are described and figured. The plates have been prepared from photographs of specimens and are good of their class, though exemplifying all the drawbacks of that process when applied to such highly convex specimens as many of the Foraminifera illustrated.

A. E.

Texas Jackson Foraminifera.—J. A. CUSHMAN and E. R. APPLIN (*Bull. Amer. Ass. Petroleum Geologists*, 1926, 10, 154–89, 1 map, 5 pls.). The Upper Eocene formation, known as the "Jackson," was formerly known only as a narrow band of outcropping clays and sandstones extending diagonally across the state of Texas. It has now been found to extend to the vicinity of the coast line and the authors claim that the foraminiferal fauna is so well known that it can be subdivided into a number of easily recognised faunules with definite stratigraphic relationships. Six separate zones are described, each named after dominant species, and lists of the characteristic species of each zone are given. Thirty-six new species and varieties are figured and described. The plates are excellent, but the map is on such a small scale as to be useless for purposes of reference.

A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

Including Cell-Contents.

Reduction-Division in *Uvularia*.—J. BELLING ("Single and Double Rings at the Reduction-division in *Uvularia*," *Biol. Bull., Washington*, 1926, 50, 355–63, 6 figs.). "A contribution to the determination of the likenesses and differences of the maturation divisions of flowering plants and those of the best known animals." Preparations of young microspores and pollen-mother-cells were used, and special attention was given to the rings seen in metaphase. Four points were investigated:—(1) Whether in horizontal rings or V's one chromatid passes up and one down each lateral half of the ring or V. (2) Whether these chromatids in separating show signs of interlacing at the junction, so that a ring or V gradually diminishes in size as its chromatids are pulled into the loop by the spindle-fibres. (3) Whether in vertical rings or V's, the process is the same as above; or whether the upper and lower halves of the rings or V's separate as wholes. (4) What different configurations are shown by the same homologous chromosomes in different cells." Observation shows that: (1) Fusion appears to take place at the junctions of the two constituents of each bivalent. (2) Horizontal rings and V's divide into their constituents along a horizontal plane seen distinctly in metaphase. (3) Vertical rings and V's probably separate into upper and lower halves. (4) Rings and V's appear to diminish as the loop between them is pulled by the spindle-fibres. This presupposes crossing or lacing of the chromatids. S. G.

Chromosomes of Genus *Crepis*.—E. B. BABCOCK and M. M. LESLEY ("Chromosome Number and Individuality in the Genus *Crepis*," *Univ. Calif. Publ. Agric. Sc.*, 1926, 2, 315–41, 7 figs.). A study of chromosomes and taxonomic relationships with the object of establishing a natural classification of the genus *Crepis*. A new grouping of the species is suggested, in which the eleven sections are reduced to ten. From the standpoint of both taxonomy and cytology *Crepis* forms a heterogeneous group of species, but the size of the chromosomes appears to afford a fairly satisfactory basis for estimating relationship. It is found that the section *Eucrepis* is capable of new sub-groupings, and it is hoped that further study may make similar sub-groups for *Catonia*. Research on species hybrids is also expected to throw light upon the origin of the chromosomal differences. Among other differences noted, that in the size of all chromosomes is especially evident. If the section *Youngia* is omitted, there is only one species—*C. bulbosa*—which has chromosomes of a smaller size than is usually found in the genus. *Eucrepis* includes *C. neglecta* and *C. parviflora* as a provisional arrangement, and *C. setosa* is in the *Barkhausia* section. The chromosomes indicate either that *Eucrepis* and *Barkhausia* are closely related, or that similar changes have taken place independently in both groups. For the present the latter conclusion appears to be the more probable. S. G.

Structure and Development.

Vegetative.

Vascular Tissues of *Microcycas calocoma*.—M. A. CHRYSLER (*Bot. Gaz.*, 1926, 82, 233-52, 3 pls., 3 figs.). In general, the xylem of *Microcycas* corresponds in structure to that of other monoxyletic genera. It is essentially similar to *Dioon*, from which it differs in having conspicuous and persistent external rings composed of leaf-bases separated by wider spaces occupied by scales. The xylem of the stem consists typically of pitted tracheids, but there is a remarkably wide inner zone of scalariform elements representing a juvenile stage; these grade into the typical adult form through a series of transitional elements. The scalariform zone shows some indication of division into a few growth rings. Endarch protoxylem is definitely present and consists of narrow tracheids with close spiral and reticulate thickenings. The persistent leaf-traces become secondarily attached to the tracheids of the woody cylinder, establishing a connection between the inner and outer wood. Pith bundles with inverse orientation occur sporadically. A small amount of centripetal xylem is found in the peduncle of the microsporangiate cone. A consideration of the various features leads to the conclusion that *Microcycas* is a distinctly advanced genus. B. J. R.

Stem-Structure in *Berberis*.—G. R. A. SMITH (*Berberis aristata*, D.C., and other Species of *Berberis*: A Comparative Study of the Structure of the Stems. *Pharmaceutical Journal and Pharmacist*, Aug. 7, 1926, 19, 12 figs.). The object of the study was to discover any characters by which the stem of *B. aristata* might be distinguished from other species of *Berberis*, so that the official drug might be definitely recognized. The structure and development of the stem of this species was therefore examined in detail, while a number of other species were studied mainly for comparative purposes. Macroscopical characters are insufficient to distinguish stems of *B. aristata* from those of closely allied species. Specific microscopical features are found in the large crescents of pericyclic fibres behind each primary phloem group, and in the character of the cork cells which have moderately thick inner tangential walls, and include amongst them occasional stone cells. The microscopical descriptions are supplemented by illustrations of the histological differences between the various species examined. B. J. R.

Development of Growth-Layers in *Fraxinus campestris* and *Acer saccharinum*.—H. C. HANSON and B. BRENKE (*Bot. Gaz.*, 1926, 82, 286-305, 3 pls., 2 figs.). An investigation of the seasonal development of the xylem in the two species named was carried out at Lincoln, Nebraska. Trees were cut down at intervals during the growing season; small blocks were cut from the trunks at a height of one foot above soil level and examined histologically. The maple was found to be similar to most trees, in that it did not show xylem production until the leaves were partly expanded (April 17-27). By August 1 most of the season's xylem had been formed, and over 90 per cent. was completely lignified. On August 15 lignification was complete to the cambium, and no new cells were being produced, but on September 14 cambial activity had been renewed and was only completed by October 14. In the case of the ash, new xylem was being produced before the leaves had started to expand or the branches to elongate (just prior to April 15). By April 27 the first row of vessels had reached maturity; by May 14 all the spring wood had been formed and lignification was proceeding rapidly. By July 15 the summer growth had almost ceased, and over 90 p.c. of the xylem

was completely lignified. Cambial activity had been resumed on one side of the trunk on August 15. By September 14 the formation of new xylem cells had ceased and lignification was complete. In the ash the beginning of xylem development was similar in trunk and twigs. In the maple it was further advanced in the twigs and decreased progressively downwards. Cambial activity, as measured by the width of the cambium-layer, showed as correlation with precipitation. A direct correlation with mean temperature appeared to exist in the spring until about 60° F. was reached, after which there appeared to be an inverse correlation.

B. J. R.

Organization and Significance of Lenticels in Dicotyledons.—R. H. WETMORE ("I. Lenticels in Relation to Aggregate and Compound Storage Rays in Woody Stems, Lenticels and Roots," *Bot. Gaz.*, 1926, 82, 71-88, 2 pls.). The writer finds that lenticels may be classified according to the orientation of the fissure. Transverse lenticels are more characteristic of the lower angiospermous affinities and longitudinal lenticels of the higher. The orientation of the cauline lenticel is correlated with the nature of the storage ray within. Thus, aggregate rays which are composed largely of uniseriate rays possess transverse lenticels, while the higher type of aggregate ray with multiseriate units is connected with a longitudinal lenticel. A similar distinction is made in forms with compound rays. Roots, irrespective of internal conditions and taxonomic affinities, invariably possess lenticels of the primitive, paired appendage type, which is characteristic of young coniferous stems and all coniferous roots.

II. ("II. Lenticels in Relation to Diffuse Storage Rays of Woody Stems." *Op. cit.*, 113-31, 4 pls.). Longitudinal lenticels are more commonly found on forms with diffuse storage rays than are transverse lenticels. When transverse lenticels occur they are always associated with vertically shorter rays. In trees such as *Tilia*, *Carya*, *Fraxinus*, in which the rays assume meristematic activity in the phloem, these broad rays are confronted by rows of lenticels, thus facilitating aeration. The organization and evolution of the rays in the stems of angiosperms has been accompanied by a parallel organization and evolution of the lenticels. In the root, the more primitive transverse lenticels, in their original relationship to the rootlets, have been retained.

B. J. R.

General.

Pollen-Grains as an aid to Classification.—R. P. WONGERSON ("Pollen-Grain Morphology in the Classification of the Anthemideae," *Bull. Torr. Bot. Club*, 1926, 53, 479-85, 2 figs.). A study of the anatomy of pollen-grains in order to discover relationships between the genera of the Anthemideae. The spiny character of the pollen-grain of the Carduales varies in such a manner, that it is always possible to say to what section of the group any species belongs. The spines are sharp, pointed cones forming a part of the exine and partly or entirely covered by the perinium which overlies the exine. The number of spines varies considerably, but they are nearly always arranged geometrically and constitute the most conspicuous character of the grain. In three separate tribes the absence of spines has been independently developed. The Mutiseae have no trace of spines, and probably arose from a spineless mutant from the Carduaceae stock. In the Cynareae the condition of the spines suggests that this tribe is becoming spineless. In the Anthemideae there is little to suggest any stage of transition, and the absence of spines is confined to seven genera—*Sphaeromeria* Nutt., *Vesicaria* Rydb., *Chamaeternisia* Rydb., *Crossostephium* Less., *Pteranthus* Nutt., *Artemisia*

L., *Artemisiastrum* Rydb. These genera appear to have arisen from a common ancestor of the Anthemideæ stock, and it is suggested that the anatomy of the pollen-grains, taken in conjunction with the grosser anatomical characters, may afford a means of establishing relationships and tracing the trend of evolution.

S. G.

CRYPTOGAMS.

Pteridophta.

Middle Devonian Flora.—D. H. SCOTT ("New Discoveries in the Middle Devonian Flora of Germany," *New Phytologist*, 1926, **25**, 373-79). An account of the discoveries revealed by R. Kräusel and H. Weyland in their monograph, "Beiträge z. Kenntnis der Devonflora, II," in *Abhandl. Senckenb. Naturforsch. Ges.*, 1926, **40**, Heft II. The fossils described are *Asteroxylon elberfeldense*, *Aneurophyton germanicum*, *Hyenia elegans*, *Calamophyton princevum*, *Cladoxylon scoparium*. The first, third, fourth and fifth are new species; and the fourth represents a new genus. They were found in the neighbourhood of Elberfeld, and belong to the lowest division of the upper Middle Devonian. They constitute the greatest addition to primæval botany since the Rhynie chert discoveries. A. G.

Fossil Pennsylvanian Plants.—J. HOBART HOSKINS ("Structure of Pennsylvanian plants from Illinois, I," *Bot. Gazette*, 1926, **82**, 427-37, 2 pls.). Sections of a coal-ball obtained from the Hegler Coal Mine were found to contain the fossil remains of a fertile frond of *Pecopteris*, which is described and referred to Stur's *Asterothecææ*. Thereupon follows a discussion of the nature of the fructification of *Asterotheca*, *Scolecopteris*, *Renaultia*, *Pecopteris*, and other Pteridosperms.

A. G.

Marsilea.—MARGARET STASON ("The Marsileas of the western United States," *Bull. Torrey Bot. Club*, 1926, **53**, 473-8). After a careful examination of all available material of *Marsilea vestita* Hook. and Grev., and *M. oligospora* Goodding, collected in the western United States, the writer has come to the conclusion that there is no clear cut distinction between these two forms, which might be spoken of as the *vestita* and *oligospora* types, in habitat, distribution, morphological characters. Possibly *M. vestita* is what Turesson calls an ecospecies—that is, a widely distributed and variable species which has, owing to ecological factors, undergone differentiation into two hereditary types.

A. G.

Epidermal absorption in Selaginella.—SALUSTIO ALVARADO ("Sobre la Estructura de la Epidermis foliar de las Selaginella," *Trabajos del Museo Nacional de Ciencias Naturales*, Madrid, 1925, Serie Botánica, Núm., 19, 1-30, 8 figs.). A description of a new structural disposition for the absorption of water by the aerial organs. The leaf epidermis of *Selaginella Martensii* and *S. Kraussiana*, and probably many other species, shows an infinity of minute intercellular pits formed by the local splitting of the lateral walls of the cells. These pits communicate neither with the interior of the epidermal cells nor with the intercellular channels of the mesophyll; the epidermis therefore is not porose. Physiologically these pits serve to retain by capillarity the drops of water which fall upon the leaves; the walls of these pits, not being cuticularized, absorb by osmosis the water retained in them by capillarity. In the ecology of *Selaginella*, especially in extreme cases, this absorbent system must play, in union with the ligule, a very important part. This absorbent apparatus of *Selaginella* is completely different from those observed in the aerial organs of all the rest of the plants, and constitutes therefore an arrangement entirely new for this function.

A. G.

Bolivian Ferns.—CARL CHRISTENSEN ("Pteridophyta": in Erik Asplund, "Contributions to the Flora of the Bolivian Andes," *Arkiv för Botanik*, 1926, Band 20 A, No. 7, 8–35, 7 figs.). An account of 124 Pteridophytes collected in the Bolivian Andes by Asplund in 1920–21, including descriptions of five new species. There are also two new species of *Selaginella* and an *Isoetes* described by Asplund. A. G.

Victorian Ferns.—H. B. WILLIAMSON ("Victorian Ferns," *Victorian Naturalist*, Melbourne, 1926, 43, 87–90; 115–8; 146–52, 4 pls.). These three instalments complete the account of the ferns of Victoria which began in the January number of the *Naturalist*. A short descriptive note is given of each species, its distribution and habitat, and its peculiarities, if any. Keys to the genera, and to the species of the larger genera, are supplied. A. G.

Japanese Ferns.—T. NAKAI ("Critical Notes of Japanese Ferns, with special references to the allied species," *Bot. Magazine, Tokyo*, 1925, 39, 101–21). A list of some 23 species, including a few new species, varieties and forms, with a key to the species of *Woodwardia*, and critical notes on *Pteridium aquilinum*, its varieties and allies, and the species and varieties of *Polystichum* that occur in Japan.

("Notes on Japanese Ferns": II, III, IV, *Bot. Magazine, Tokyo*, 1925, 39, 176–203; 1926, 40, 239–75, 371–400, 2 figs.). These papers are a continuation of the preceding, and treat of (II) Gleicheniaceæ, Salviniaceæ, Ophioglossaceæ, Equisetaceæ, Lycopodiaceæ, Selaginellaceæ; (III) Hymenophyllaceæ, with Keys to the species; (IV) Ophioglossaceæ, and *Drymoglossum*. For the systematic study of Japanese ferns these papers are likely to prove indispensable. A. G.

Adanson's Ferns.—T. NAKAI ("Filices Adansonianæ," *Bot. Magazine, Tokyo*, 1926, 40, 59–68). A discussion of "what are *Dryopteris*, *Nephrodium*, *Polystichum* and *Aspidium*?" *Dryopteris* was created by Adanson in his *Familles des plantes*, II, 21 (1763), but insufficiently defined. Christensen has established it in his *Index Filicum*. But no one had seen Adanson's specimens; and their existence was doubted. They were, however, traced and purchased by the Muséum d'histoire naturelle of Paris in 1923. Nakai has examined the ferns, and finds Adanson's *Dryopteris* to consist of eight genera, among which the modern *Dryopteris* receives the largest number of species, and thus maintains priority—unless *Thelypteris* Schmidel (1762) takes precedence. *Nephrodium* Michaux (1803), when first defined, included species which are now referred to eight genera. *Aspidium* Swartz (1801) contained 70 species belonging to eleven modern genera. *Polystichum* Roth (1800) contained twelve species now referred to four genera. *Rumohra* Raddi (1819) and *Hypopeltis* Michaux (1803) need mention. Adanson's specimens are all labelled in his own MS., and are of widespread origin; but the collectors are quite unknown. Nakai discusses the fern names in the light of Adanson's herbarium. A. G.

Bryophyta.

Targionia.—MARIA BAPTISTA MOREIRA ("Algumas notas sobre o gametófito e esporófito da *Targionia hypophylla*," *Boletim Soc. Broteriana, Coimbra*, 1922, 1, 141–51, 1 pl.). Some notes on the gametophyte and sporophyte of *Targionia hypophylla*. The development of the archegonium is that normal to the Hepaticæ. The phases observed and figured are, on the whole, similar to those represented in

the figures published by previous authors. But the author cannot agree with writers who have described the walls of the venter as formed of a single layer of cells, for she finds the archegonia even before fecundation to have two layers of cells in the ventral wall. The development of the sporophyte follows the general scheme of development in the hepatics. Some botanists state that from the foot of the sporophyte of hepatics emerge pluricellular rhizoids, which have the function of suckers. If these prolongations really exist, they are not found in *Targionia*, in which plant the food material must pass directly from the gametophyte to the foot, and thence to the capsule through the pedicel, which in this genus is reduced to a small constriction.

A. G.

Preissia.—ARTHUR W. HAUPT ("Morphology of *Preissia quadrata*," *Bot. Gaz.*, 1926, **82**, 30-54, 2 pls. and 16 figs.). An account of the structure and development of *Preissia quadrata*, founded on American material. The thallus is dichotomous when young, and forms apical innovations later; it has no distinct midrib; it bears smooth and pegged rhizoids as well as appendaged scales on the lower surface. The air-chambers of the upper surface are of schizogenous origin, and contain green filaments. All air pores are barrel-shaped. The epidermal cells are thin-walled and contain few chloroplasts. The colourless ventral cells are elongated and have thickened, pitted walls; and sclerotic cells are scattered in the ventral region. The apical cell is single and cuneate; after a receptacle has arisen, another apical cell forms an apical innovation which carries on the growth of the thallus. Both male and female receptacles are stalked, and each represents a branch system; elongation of the female receptacle stalk is delayed. Each receptacle has four growing points normally, but the male varies more in this respect than does the female. The female receptacle has four inconspicuous lobes and four prominent ridges, these latter being incipient rays; and usually 4-5 archegonia are formed in each of the four groups. Most of the male receptacles appear in the early part of the growing season; most of the female ones in the later part; and most of the bisexual ones occur during the middle of the season. On bisexual receptacles the antheridia are formed before the archegonia. All thalli contain the potentialities of either sex. The general form of the receptacle is determined by the kind and number of the sex organs it produces. The antheridia develop as in other Marchantiales; the formation of periclinal walls delimiting the spermatogenous cells involves the three uppermost tiers of cells of the young antheridium. The archegonium also develops normally; the ventral canal cell and egg are differentiated after four neck canal cells are formed; this number is not later increased. At the time of fertilization there is sometimes a centrosome with astral rays. The haploid number of chromosomes is nine, one being very small. The development of the embryo exhibits the octant stage characteristic of certain related genera. A functioning apical cell does not occur in the embryo of the Marchantiales.

A. G.

Marchantia.—MARY ELLEN O'HANLON ("Germination of spores and early stages in development of gametophyte of *Marchantia polymorpha*," *Bot. Gaz.*, 1926, **82**, 215-22, 4 pls.). A study of *Marchantia polymorpha* under cultivation, to test whether there is a definite apical cell in the gametophyte. Incidentally the results show that the number of spores in a single head is about seven millions; and the ratio of elaters to spores is 1:128. The spores retain vitality for a year. The germinating spore produces one primary rhizoid, rarely two. Normally when the primary green filament is 3-4 cells long, cell division in a different plane begins, and a variety of forms results; branching of the young thalli is not uncommon,

even at a very early stage. A marginal row of meristematic cells is early established, and these, rather than a single apical cell, are active throughout subsequent development. By differential growth in the cells of this marginal row an apical notch is formed when the young gametophyte comprises 30-40 cells. Dorsiventrality and anchorage are established by the budding off of rhizoids behind the apical notch, and by the rise of mucilage cells on the lower side of the apex. About 14 hours of good light is the optimum, but much less during germination. The optimum temperature conditions for vegetative growth are 18-22° C., and for fruiting are 10°-15° C. For successful germination a solid substratum is better than a liquid one. A. G.

Riccardia pinguis.—AMOS M. SHOWALTER ("Studies in the Cytology of the Anacrogynæ. II. Fertilization in *Riccardia pinguis*," *Ann. of Bot.*, 1926, 40, 713-26, 3 pls. and 4 figs.). Fertilization in a bryophyte has so far been adequately studied in *Sphaerocarpus* only (Rickett, 1923). In the present paper fertilization in *Riccardia pinguis* is described. It is stated that the penetration of the antherozoid into the egg takes place gradually in 20-30 minutes; the antherozoid is at once reduced to half its thickness; and apparently only the nucleus enters the egg. For 24-36 hours the male nucleus remains unchanged in the egg, whilst the egg increases greatly in size and the chromatin of the egg-nucleus becomes aggregated about the nucleolus. The male nucleus penetrates endwise and very gradually into the female nucleus. The chromatin of the latter, previously aggregated round the nucleolus, loosens up and becomes somewhat thread-like. The maternal and paternal chromatin are distinguishable for about two days after the union of the two nuclei, but become indistinguishable before the prophase of the first mitosis. The zygote increases greatly in volume and produces a haustorium before its first segmentation. The early development of the embryo is described briefly. A. G.

Zygodon.—N. MALTA ("Die Gattung *Zygodon* Hook. et Tayl. Eine monographische Studie," *Latvijas Universitātes Botaniskā Darbi*, No. 1, Riga, 1926, 1-185, 1 pl. and 104 figs.). An illustrated monograph of all the species of *Zygodon* with uniform descriptions, distribution, critical remarks and keys. The genus is divided into four sections—*Euzygodon* with 66 species; *Stenomitrium*, 1 species; *Bryoides*, 9 species; *Obtusifolii*, 1 species. *Zygodon viridissimus* is widely distributed in Europe, N. Africa, and N. America, and comprises several forms, some of which have been regarded as species. This careful and well-considered monograph greatly facilitates the study of a difficult genus. A. G.

Swedish Bryophytes.—S. MEDELIUS ("Mossvegetationen i Storlien med omnejd," *Arkiv för Botanik*, 1926, Band 20 A, No. 10, 1-77). An account of the mosses and hepatics in the neighbourhood of Storlien in Jämtland, with their distribution, altitude, fertility, etc., and often with field notes. A. G.

Russian Bryophytes.—J. PODPĚRA ("Ad Bryophytorum Cisuralensium cognitionem additamentum," *Publ. Faculté Sci. Univ. Masaryk, Brno*, 1921, pt. 5, 1-42, 27 figs.). A list of 14 hepatics, 6 sphagna, 150 mosses, with several varieties and forms, some new to science. They were gathered in 1917 near Ufa, at the western foot of the Ural Mountains, and are published as a contribution to the geographical distribution of the Russian moss flora. Much critical work has been devoted to the forms of *Brachythecium salebrosum*, the varieties and forms of the species of *Amblystegium* and *Leptodictyum*, *Chrysohypnum*. A. G.

Polish Bryophytes.—J. MONDELSKA ("Aperçu de flore des Mousses du district de Leszno," *Kosmos*, 1925, **50**, 1323–30). A list of 90 bryophytes gathered in the district of Leszno, about half of them being additions to the Polish flora. The species are arranged in groups according to habitat. A. G.

Mosses from Gilgit.—H. N. DIXON ("Mosses collected in Gilgit, etc., by J. Garrett and W. Lillie," *Records of the Botanical Survey of India*, 1926, **9**, 303–13, 1 pl.). A list of fifty mosses gathered in the Agency of Gilgit, the most northerly district of the State of Kashmir and of the Indian Empire. Among them are described six new species and one variety. A. G.

Thallophyta.

Algæ.

Baltic Phytoplankton.—B. NAMYSŁOWSKI ("Contribution à la connaissance du phytoplancton de la Baltique," *Kosmos*, Lwow, 1925, **50**, 1352–4). A supplement to the phytoplankton flora of the Polish shores of the Baltic, in relation to the author's previous publication. Contrary to ordinary experience, it is not *Aphanizomenon flos-aquæ* which appears en masse, but *Nodularia spumigena* which impresses, however briefly, its character on the phytoplankton. A. G.

Welsh Phytoplankton.—B. MILLARD GRIFFITHS ("Studies in the Phytoplankton of the Lowland Waters of Great Britain, No. IV.: The Phytoplankton of the Isle of Anglesey and of Llyn Ogwen, North Wales," *Journ. Linn. Soc. Bot.*, 1926, **47**, 355–66). Five lakes were examined in Anglesey, and the phytoplankton results are tabulated; the phytoplankton flora of Llyn Ogwen is also given. The algal flora of these lakes is of much interest in reference to the relationship of the desmid type of plankton to the lowland type exhibited in the waters of Shropshire, Cheshire and elsewhere on the great European plain. This aspect is discussed at some length. A. G.

Heterokontæ.—E. M. POULTON ("Studies on the Heterokontæ," *New Phytologist*, 1926, **25**, 309–37, 13 sets of figs.). An abridgment of a thesis published in 1925 in Geneva, where the investigations were made. Five genera were studied—*Chlorobotrys*, *Botrydiopsis*, *Characiopsis*, *Heterococcus*, *Tribonema*; and a representative of each of these genera is described in detail, figured, and discussed. There are about twenty-two genera of Heterokontæ, and a more detailed knowledge of most of them is desired. The present five genera have pronounced structural and physiological features in common—for example, the numerous discoidal yellow-green chromatophores; the chlorophyll is associated with xanthophyll; there is an entire absence of starch, which is replaced by oil-granules. There is a uniformity of structure of the motile spores, which have two unequal cilia. The reproductive process is comparatively simple—vegetative division, non-motile spores, zoospores; no fusion of gametes has been observed. The paper concludes with some general remarks on the Heterokontæ. A. G.

Vaucheria.—M. M. WILLIAMS ("Contributions to the Cytology and Phylogeny of the Siphonaceous Algæ, Part II, Oogenesis and Spermatogenesis in *Vaucheria geminata*," *Proc. Linnæan Soc. of New South Wales* for 1926, **51**, 282–95, 16 figs.). The results arising from a study of the cytology of *Vaucheria* are as follows:—The young oogonia and antheridia are multinucleate; by degeneration of the super-numerary nuclei the oogonium comes to be uninucleate. No mitoses occur during the development of the sexual organs. The factors controlling the selection of the

functional nucleus are unknown. The centre of the fertilized oogonium is a mass of dense granular matter, probably of a nutritive nature for the most part, and derived by osmosis from the coenocyte. The supernumerary oospheric nuclei represent potential gameto-nuclei, homologous with the functional nucleus. The Vaucheriaceæ are regarded as derived primarily from a *Cladophora* type with gametangia liberating free gametes, through types (probably extinct) with multinucleate gametangia producing non-individualized gametes, these giving rise to multinucleate types with differentiated gametangia containing non-individualized gametes in the oogonium. The Vaucheriaceæ probably represent an end line of development, since they are too highly specialized to have given rise to any other types. A. G.

Portuguese Desmidiææ.—J. SAMPAIO ("Desmidiaceas da bacia do Lima (1 série)," *Boletim Soc. Broteriana*, Coimbra, 1922, 1, 152-67, 1 pl.). A list of 64 desmids with short descriptions, gathered in the autumn in the lower part of the Lima river basin; 26 of the species being new records for Portugal, and four of them new to science. In the plate, 16 species and varieties are figured.

("Subsídios para o estudo das Desmidiáceas Portuguesas," *Boletim Soc. Broteriana*, Coimbra, 1923, 2, 153-60, figs.). Records of thirty-four desmids collected in Portugal, with short descriptive notes and remarks. A. G.

Oedogonium.—H. OHASHI ("Oedogonium nebraskensis, sp. nov.," *Bot. Gaz.*, 1926, 82, 207-14, 20 figs.). Study of an alga from a pond at Lincoln, Nebraska. Though it might be referred as a variety of *Oedogonium concatenatum* in respect of the dimensions of its oogonium and oospore, and of the diameter of the vegetative and suffultory cells, yet there is a distinctive difference in the length of the vegetative and suffultory cells. Also the marking of the median spore coat of the oospore of *O. nebraskensis* differs from that of *O. concatenatum*. And most characteristic is the position of the pore in the oogonium, supramedian instead of superior. A. G.

Carpomitra.—C. SAUVAGEAU ("Sur l'alternance des générations chez le *Carpomitra Cabrerae* Kütz.," *Bull. Station Biolog. d'Arcachon*, 1926, tome XXIII, 141-92, 17 figs.). An account of the life-history of *Carpomitra Cabrerae*, in which the author has discovered a sexual generation in addition to the asexual generation which is known to us; moreover, between the gametophyte and the true sporophyte there is an intervening stage the pro-embryo. It is extremely probable too that other genera of Sporochneaceæ, namely, *Sporochneus* and *Nereia*, also possess an alternation of generations. The zoospores of the unilocular sporangia of *Carpomitra* germinate into branched monosiphonous filaments which are monoicous, some bearing antheridia, others oogonia. But in the cultures no fecundation was observed; apogamy was constant. From the oogonium arises a pro-embryo, one of the cells of which eventually becomes differentiated into a meristem which grows into a young *Carpomitra* plant. All this is worked out in detail and figured and discussed. A. G.

Fucus lutarius and Iodine in Algæ.—C. SAUVAGEAU ("Sur le *Fucus lutarius* et sur l'iode libre de certaines algues," *Bull. Station Biologique d'Arcachon*, 1927, XXIV, 1-12). A repudiation of certain statements attributed by E. Chemin to the author, who once more makes clear his view that *F. lutarius* is a composite and provisional species, a mud-growing adaptation of two or more commoner species; and that it needs further investigation. The author also restates clearly the facts of his discovery of the existence of free iodine in young special organs in

certain Florideæ, *Asparagopsis*, *Falkenbergia*, *Bonnemaïsonia*; and a similar discovery of free bromine in *Antithamnion* and *Antithamnionella*. In stale specimens and the older parts of the plants the iodine is in combined form. The author criticizes the published work of Chemin and Legendre (1926), who have failed to find receptacles of free iodine in *Falkenbergia*. A. G.

Giraudya.—C. SAUVAGEAU ("Sur les problèmes du *Giraudya*," *Bull. Station Biologique d'Arcachon*, 1927, tome 24, 1-75, 18 figs.). *Giraudya*, though appearing to lack unilocular sporangia, possesses three sorts of plurilocular sporangia:—(1) with sori arranged like a muff; (2) with sori arranged like a pustule; (3) basilar sporangia. No other member of the Phæosporeæ possesses so many. They differ from one another in their origin and in the product of germination of their zoospores. These latter have never been observed to conjugate like gametes. The germinating zoospores produce a fertile prothallus; Sauvageau has never at Banyuls met with the sterile disc seen by Berthold and Kuckuck; is it possible that the *Giraudya* at Naples possesses a fourth kind of sporangium which gives rises to these proliferous discs? (1) The zoospores of the muff-like sori produce heteroblastic prothalli, discs or ectocarpoid filaments, quickly and abundantly fertile, thus multiplying the zoospores of their plurilocular sporangia. After several months of cultivation plantules of *Giraudya* appear on the filamentous prothalli. (2) The zoospores of the pustula-like sori produce filamentous prothalli larger than the foregoing and of different form, slowly and but little fertile; and no plantules of *Giraudya* have been observed upon them. (3) The zoospores of the basilar sporangia produce prothallia of yet another form, but as rapidly and abundantly fertile as those that come from the muff-like sori. Like these latter, and by the same process, they also produce plantlets of *Giraudya*. The development of *Giraudya* is more difficult than was expected, and calls for further and prolonged research. A. G.

Protoplast in Ceramium and Dasya.—R. W. PHILLIPS ("On the form of the Protoplast in cells of the genus *Ceramium* and those of *Dasya coccinea*," *New Phytologist*, 1926, 25, 277-93, 12 figs.). Attention is called to the existence of a strong trabecula of protoplasm which runs from pit to pit down through the centre of the vacuole in all the axial cells of *Ceramium*, and somewhat similarly in *Dasya coccinea*. It can be seen clearly in all fresh specimens, in properly fixed material, and even in some dried herbarium material. It is seen too in *Microcladia*, confirming the close affinity of this genus with *Ceramium*; but it is not found in *Spyridia*. The author describes and figures what he observed in *Ceramium ciliatum*, *C. echionotum*, *C. strictum*, *C. rubrum*; also in *Dasya coccinea*, where there is a difference of detail. The function of the trabecula would appear to be the transport of food material, and possibly also the transference of stimulus from part to part. Sometimes vacuolization of the trabecula is to be observed. A. G.

Fossil Melobesieæ.—J. PFENDER ("Sur les organismes du Nummulitique de la colline de San Salvador près Camarasa, province de Lérida, Catalogne," *Boletín R. Soc. Española Hist. Nat., Madrid*, 1926, tom. XXVI, 321-30, 8 pls.). Descriptions and photographs of five Melobesieæ from the nummulitic limestone near Camarasa in the Spanish province of Catalonia, including two new species of *Archæolithothamnium*, and a new species of *Lithothamnium* and *Solenomeris*. A. G.

Fungi.

The genus Ligniera Maire and Tison.—W. R. IVIMEY COOK (*Trans. Brit. Mycol. Soc.*, 1926, 11, 196-213, 2 pls.). "In the genus *Ligniera* have been placed those Plasmodiophoraceous fungi which cause practically no hypertrophy of the

host tissues. They occur solely in the roots of Phanerogams." Cook gives a historical account of these organisms, finally giving the descriptions of the species recognized by Maire and Tison :—*L. verrucosa*, *L. radicalis* and *L. Junci*. The last has been described under a number of names according to the host plant, and it is to that species that the author has directed special attention. Successful inoculations provided a wealth of material, and enabled the writer to make a careful cytological study. His methods and observations are described at length. Zoospore formation was followed, and their entrance to the root by the root hairs was followed. Reductive divisions were observed at the time of formation of both spores and zoospores. Conjugation was not seen. Cook here classifies the Plasmodiophoræ with fungi rather than with the Mycotozoa. A. L. S.

Urophlyctis Potteri Bartl.—A. W. BARTLETT ("On a New Species of Urophlyctis producing Galls on *Lotus corniculatus* Linn.," *Trans. Brit. Mycol. Soc.*, 1926, 11, 266–81, 4 pls.). The galls were discovered on the stalks of *Lotus* in the region of the "collar," i.e. just above the surface of the ground, occasionally they are found on the creeping underground stems. The largest galls measure about 1 cm. in the longest diameter, the average size is smaller. The infected plants grew in the lowest and dampest part of a pasture field, and were quite healthy, though they produced no flowers, a characteristic of *Lotus* plants in damp situations. The galls were examined, and their development traced by teasing them out and observing the different stages of fungus growth. A careful description is given of the various structures, not only of the galls, but the hyphæ and sporangia, etc. A study was also made of the cytology, and the phenomena observed have been figured on the plates. The writer finally gives his reasons for placing the fungus in the Chytridiaceous genus *Urophlyctis*, and also for considering it as a new and hitherto undescribed species. A. L. S.

Nectar-Yeasts.—TADAO JIMBO ("Yeasts isolated from Flower Nectar," *Sci. Reports Tôhoku Imp. Univ., Sendai, Japan*, 1926, 2, 161–87, 2 pls.). There has been considerable investigation by European workers as to the presence of yeasts in various plants—in the flower nectar, on the stigmas, and on other parts of the flower, etc. About ten or twelve forms have been isolated of various colours, brown, pink, etc. Jimbo investigated the nectar of 273 flowers of twenty-three species of plants. Almost all of them were infected by yeasts which could be distinguished in twenty-two forms, ten forms of which were scarce. The rate of infection increased with the seasonal rise of temperature. Ascospore formation was never observed in the cultures. A pink yeast was peculiar, in that it formed oil in the cell and out of the cell. The author gives a list of the plants investigated, and tables setting forth the times of infection, the form of the yeasts, etc. A. L. S.

Australian Ascomycetes.—ETHEL M'LENNAN and ISABEL COOKSON ("Additions to Australian Ascomycetes," *Proc. Roy. Soc., Victoria*, 1926, 38, 69–76, 3 pls.). The writers record seven species of *Lamprospora*, minute plants which grow among moss, and are generally brightly coloured and with smooth or sculptured globose spores; most of those described are new species. Species of *Pseudoplectania*, *Plectania*, *Sphaerosoma*, and *Cordyceps* are also recorded. The last-mentioned, *C. Brittlebankii*, arose from the head of a cockchafer beetle. It has affinities with a recently described Ceylon species, *C. Blattæ* Petch, but differs in various respects. A. L. S.

Study of Ascomycetes.—V. LIKHITÉ ("Développement et Biologie de quelques Ascomycètes," *Rev. gén de Bot.*, 1926, 38, 5–30, 95–106, 146–63, 191–201,

239-51, 8 pls.). Likhité has made a study of three Ascomycetes—*Gnomonia leptostyla*, *G. erythrostoma* (Pyrenomycetes) and *Lophodermium hysterioides* (Hysterineæ), in which he has traced development of the fruiting bodies from the spiral coil to the formation of the ascospores. He has noted the differences in the form of the ascogonia and their nuclear content. In *Hendersonia Urticæ* (Sphæropsideæ) he claims to have traced the formation of a second type of pycnidium (or perithecium) in which there are traces of ascogonial formation, the cells of which degenerate without forming asci. In *Ramularia Urticæ* (Hyphomycetes), he also traces a degenerate perithecium with a sort of ascogonium formed of cells with larger nuclei than those of the vegetative cells. As in *Hendersonia* the ascogonium degenerates without forming asci.

A. L. S.

Study of Vermicularia.—C. KILLIAN ("Caractères morphologiques du *Vermicularia Eryngii* (Corda)," *Bull. Soc. Mycol., France*, 1926, 42, 51-61, 3 pls.). *Vermicularia* is characterized by the vermiform spores, and by the long hairs on the fruiting body. *V. Eryngii* grows on the dead petioles of *Eryngium campestre*. The author cultivated it on artificial media, and noted the variations occasioned by different media, especially with regard to the sources of nitrogen and carbohydrates in these. Finally he compares *V. Eryngii* with allied species.

A. L. S.

Study of Development in Coniothyrium.—F. VINCENS ("Mode de formation et structure des conceptacles du *Coniothyrium concentricum*," *Bull. Soc. Mycol., France*, 1926, 42, 178-85, 4 text-figs.). This posthumous paper of F. Vincens has been edited and published by René Maire. The fungus grew on the leaves of *Yucca*, and was easily cultivable on artificial media. He found that a mass of septate hyphæ was developed from the original hypha; a cavity was formed in the centre, and the cells of the internal wall budded off innumerable spores which emerged by a pore. In spore formation it differs from a true pycnidium.

A. L. S.

Study of Fern-Rusts.—E. H. MOSS ("The Uredo-stage of the Pucciniastreæ," *Ann. Bot.*, 1926, 40, 813-47, 1 pl., 21 text-figs.). Moss has examined the uredo-stage of fourteen species of Pucciniastreæ, a sub-family of Melampsoraceæ. Only six of the species belonging to the genera *Hyalopsora*, *Uredinopsis* and *Milesina* were fern parasites, the other eight species grew on flowering plants, the alternate stages on other hosts are not considered. The investigation proved that the uredospores are pedicellate throughout, and that they bud out singly from sporogenous cells at the base of the sorus, resembling the uredospore formation in the Pucciniaceæ. A uredoperidium occurs in all the genera; germ-pores are characteristic and haustoria are of common occurrence; the stages in penetration of the host-cell and subsequent development are described throughout the work, comparison is made with allied genera. A full bibliography is supplied.

A. L. S.

Gallowaya, an offshoot of the Coleosporiæ.—FERNAND MOREAU ("Gallowaya un rameau endophylléen des Coleosporiées," *Bull. Soc. Mycol. Fr.*, 1926, 42, 175-6). Moreau gives here a phylogentic study of *Gallowaya* based on Dodge's study and figures of *Gallowaya pinicola*. He claims for this uredine a place as link between those with a complete cycle of development and those in which are suppressed the uredo and teleuto stages: the aecidial spore in these forms germinates in a promycelium which takes the place of the absent teleutospore. Finally, he

states his conclusion that the genus *Gallowaya* is descended from a *Coleosporium* of which the first aecidial form was a *Cæoma*, and that it is therefore an endophylline branch of Coleosporiææ.

A. L. S.

Cytology of *Cæoma nitens*.—B. O. DODGE and L. O. GAISER ("The Question of Nuclear Fusions in the Blackberry Rust, *Cæoma nitens*," *Journ. Agric. Research*, 1926, 32, 1003–23, 4 pls.). Some confusion has been due to the existence of specialized or biologic forms of this rust; the authors have taken up the task of clearing up the difficulties of the *Cæoma* form of *Gymnoconia interstitialis*, the *Rubus* rust. They found that most of the æcidiospores originated without cell-fusions and were uninucleate, though in other strains cell-fusions occurred regularly, and the spores were binucleate. There is also a third type of spore that may become multi-nucleate. The writers have proved that there is no nuclear fusion at any stage of development. They have followed the movement of the two nuclei in the fused cell, their ultimate division into four nuclei and the formation of the promycelium. A contrast is drawn with the process of spore development in the Florideæ. They hold that the effects of cell-fusion are as potent as sexual fusions, and the Ascomycetes may very well have been evolved from the red algæ when the tip of a diploid filament bent round and fused with its subterminal cell.

A. L. S.

Notes on Hymenomycetes.—R. MORQUER ("Sur quelques Hyménomycètes épixyles récoltés dans les vallées pyrénéennes et leur développement exceptionnel à haute altitude," *Bull. Soc. Mycol. Fr.*, 1926, 42, 186–7). Morquer records a number of Polypores collected in high Pyrenean valleys which were almost double the normal size: among others *Lenzites quercina*, *Ganoderma applanatum*, etc.

A. L. S.

***Clitocybe gyrans*.**—L. HILLIER ("Le *Clitocybe gyrans* dans les environs de Besançon," *Tom. cit.*, 188–9). Hillier found crowded colonies of this rare species on ground rendered bare of grass, it being the site of piles of hay. The fungus is edible.

A. L. S.

New Hosts for Fungi.—G. NICOLAS ("Un nouvel rôle de *Ganoderma applanatum*," *Tom. cit.*, 190–1). This Polypore has been recorded from many trees, the new host is a Mulberry growing near Toulouse.

("Un nouvel rôle d'*Ungulina pazinea*," *Tom. cit.*, 192–3). The new host recorded by Nicolas is a very old elm, also in the neighbourhood of Toulouse. Nicolas gives the names of previous hosts of these two fungi along with their complete synonymy.

A. L. S.

***Rhacophyllus* B. and Br.**—T. PETCH (*Trans. Brit. Mycol. Soc.*, 1926, 11, 238–51, 1 pl., 2 text-figs.). This genus has always been somewhat of a puzzle; it was instituted by Berkeley and Broome in the Fungi of Ceylon as a new genus of Agaricaceæ. The fungus has the general appearance of a small *Psathyrella* or *Coprinus*, but instead of forming gills and spores it produces bulbils in lamellar series. The fungus can be reproduced by the bulbils, which become sclerotoid and consequently are able to survive conditions adverse to growth. Petch considers there is no sufficient reason why *Rhacophyllus* should not be regarded as an autonomous genus. It has been suggested that the peculiar formation might be due to insects, but that has been proved incorrect. *Rh. lilacinus* occurs in Ceylon, and further specimens have been collected in Tonkin. Specimens reported from Tunis are probably specifically different.

A. L. S.

Revision of Agarics.—P. BRÉBINAUD ("Contribution a la révision des Agaricinées," *Bull. Soc. Mycol. Fr.*, 1926, 42, 121–9). Brébinaud has included here observations on a number of species that are to be found late in the season under pine trees. The date and the locality have induced certain changes in growth and appearance, and he discusses these. He has stated that he attaches great importance to odour and taste of the fungi he has examined. One he characterises as with an odour of Marseilles soap. A. L. S.

Notes on Practical Mycology.—P. DUMÉE ("Notes de Mycologie pratique," *Tom. cit.*, 170–4). These notes consist of a long and thorough examination of published descriptions, with personal observation of *Phylloporus rhodoxanthus* Schw. It has been recorded under twelve different names and in several genera. Dumée reprints and compares the various diagnoses: finally he follows Saccardo in classifying it under *Gomphidius*. Similar attention is given to *Tricholoma pseudo-acerbum*, which he considers to be identical with *T. Guernesaci* an older determination. A. L. S.

American Basidiomycetes in France.—R. HUMBLLOT ("Notes sur deux espèces Américaines récoltées aux environs de Paris"), *Tom. cit.*, 75–8, 1 pl. col., 3 figs.). The species in question are *Goniphidius tomentosus* Murrill and *Leptonia dysthales* Atk., both of them found growing in troops in the woods near to Paris. Full descriptions are given. A. L. S.

Carpathian Basidiomycetes.—ALBERT PILAT ("Les Agaricales et Aphyllophorales des Carpathes Centrales," *Tom. cit.*, 81–120, 2 pls., 2 text-figs.). Pilat gives here a list of the fungi observed by him on the High Tatra during June, July and August, 1924. They are arranged under Agaricales in which the hymenium is originally covered by a veil, and Aphyllophorales in which it is exposed from the beginning. It is a long list, generally with full references and always with localities. On the plates are drawn microscopic characters, especially of cystidia. A. L. S.

Australian Fungi.—G. H. CUNNINGHAM ("Gasteromycetes of Australasia. V. The genus *Calvatia*," *Proc. Linn. Soc. New S. Wales*, 1926, 51, 363–8, 2 pls.). Species of *Calvatia* have been frequently classified under *Lycoperdon*. They differ in the opening of the peridium when mature. In *Lycoperdon* there is an apical aperture or pore: in *Calvatia* the upper half of the peridium breaks away. Cunningham has recorded four species from Australia or from N. Zealand, all of them somewhat cosmopolitan. The most abundant species is *Calvatia candida*, which is also European. A new variety, var. *fusca*, from S. Australia is described. A. L. S.

African Fungi.—P. A. SACCARDO, G. BRESADOLA and C. G. LLOYD ("Fungos da Africa occidental," *Bol. Soc. Brot.*, 1922, 1, 138–40). The fungi enumerated were collected on the Island of St. Thomé and in Angola. Five new species are described by Bresadola. A. L. S.

Fungi from Costa Rica.—H. SYDOW ("Fungi in itinere costaricensi collecti. Pars secunda," *Ann. Mycol.*, 1926, 24, 283–426). Regarding this collection, Sydow notes that the trees belonging to Lauraceæ are very frequently the hosts of fungi; next to that family the Melastomaceæ harbour most species. The fungi collected are largely micro-fungi: there is one species of Phycomycetes, *Albugo Ipomœæ-panduranæ*, and one of Basidiomycetes, *Clinoconidium bullatum* n. sp. A very large number of new species have been discovered, all of them

described at great length. The new genera are :—*Cystomyces* and *Chrysella* (Uredineæ); *Microcallis*, *Allosoma*, *Aphanostigme*, *Pyrenostigme*, *Parabotryon*, *Achorodothis* (Pyrenomycetes); *Metabotryum* (Sphaeropsidæ); *Acrodesmis* (Hyphomycetes). Many of the species are parasitic on leaves: the host and locality are given. The species are not numbered, but the new species evidently exceed in number those previously described. A. L. S.

Portuguese Fungi.—R. G. FRAGOSO ("Contribución a la Flora Micológica Lusitánica," *Bol. Soc. Brot.*, 1926, 2 (II. Sér.), 2–83, 25 text-figs., 1 col. pl.). Fragoso has listed 301 species of fungi, mostly micro-fungi. Many new species are described and figured. One of these, illustrated by a coloured plate, *Nectria Sampaioi*, was found on a decaying thallus of *Lobaria pulmonaria*. Three species of Myxomycetes are included in the list. A. L. S.

Fungi from Dominica.—R. CIFERRI and R. GONZALEZ FRAGOSO ("Hongos parásitos y saprofitos de la Republica Dominicana (7th serie)," *Bol. Real Soc. Esp. Hist. Nat.*, 1926, 26, 470–80, 13 text-figs.). The fungi described are all micro-fungi: many of them are new to science, and have been described and figured by the writers. They are mostly Pyrenomycetes and Sphaeropsidæ found on leaves, wood, etc. Two Mycetozoa are included—*Arcyria cinerea* and *Hemitrichia clavata*. A. L. S.

Study of Mycorrhiza.—H. PRAT ("Étude des Mycorrhizes du *Taxus baccata*," *Ann. Sci. Nat. Bot.*, 1926, Sér. 2, 8, 141–63, 15 text-figs.). The writer found no ectotrophic mycorrhiza in the roots of the yew. Normally an endotrophic intracellular mycelium is present and enters by the root hairs. The cortex alone is invaded, the central cylinder being protected by the endodermis. The association of the fungus hyphæ with the roots is constant, and according to the writer constitutes a true instance of symbiosis. A. L. S.

Taxonomy of Dimerium.—R. A. TORO ("*Dimerium*, un paso hacia la estabilidad taxonomica," *Bol. Real Soc. Esp. Hist. Nat.*, 1926, 26, 342–4). A question of priority, as Toro states that *Dimerium* as a generic name is forestalled by *Lemboria* Lév. He thinks, however, that *Dimerium* ought to remain if use and want are to count in the re-arrangement of names. A. L. S.

Notes on Variation in Spore Descriptions.—R. MAIRE ("Remarques sur les causes de divergences entre les auteurs au sujet des dimensions des spores," *Bull. Soc. Mycol. Fr.*, 1926, 42, 43–50). In this paper the author takes note of the divergences to be found between the published dimensions of spores and the sizes determined by the worker. He gives a statement of the cause of the discrepancies, and finally advises any student to publish his own results after the record of the first diagnosis and to append his own name. A. L. S.

Essay on the Higher Fungi.—R. HUMBLLOT ("Essai d'étude anatomique des Champignons supérieurs," *Tom. cit.*, 73–4). Humblot points out in this short paper the balance that should be kept between microscopic and macroscopic characters. He insists also on the necessity of understanding truly generic characters before attempting new classifications. A. L. S.

Notes on the Fungi of Epping Forest.—J. RAMSBOTTOM (*S.E. Union of Scientific Societies' Outline, Sci. Surv., Essex*, 1926, 116–21). As regards fungi, the author states that probably Epping Forest may be regarded as the best worked area in the world, and yet hardly a year passes but that some quite distinct fungus

is added to the record. He gives a stretch of the micro-fungi to be found there; the macro-fungi, including Ascomycetes and Basidiomycetes, are next reviewed, with the localities in which they are likely to be found. Finally, a note is added as to the presence of *Mycorrhiza* and its association with the higher fungi. A. L. S.

Mycological Studies.—R. MAIRE ("Études Mycologiques, fasc. 3," *Bull. Soc. Mycol. Fr.*, 1926, 42, 40–42). The first of these studies deals with *Clitocybe geotropa* which has been found by Maire to contain hydrocyanic acid, a property shared as far as is known by only four other Basidiomycetes. In the above case the acid occurs only in the hymenium. Maire also describes a new species, *Trametes amygdalea*, in which hydrocyanic acid is exhaled from every part of the carpophore, and even from the mycelium in pure cultures. The author changes the generic name *Andreæa* (given to a Hyphomycete but already employed as a bryophyte) to *Palmomyces*. A. L. S.

Mycological Notes.—E. GILBERT ("Bribes Mycologiques," *Tom. cit.*, 62–72, 1 pl., 4 figs.). The notes concern three new species of Basidiomycetes. Macroscopic and microscopic descriptions are very full, and a coloured plate gives a clear representation of the fungi. They were collected in widely separate localities in France. A. L. S.

New Mexican Fungus.—R. G. FRAGOSO ("Hypoxylon *Herrerae* Gz. Frag. y *Stagonopsis Zinniae* Gz. Frag., Nongos mievos de Mexico," *Bol. Real Soc. Esp. Hist. Nat.*, 1926, 26, 319–21, 4 figs.). The new fungus, collected by Dr. Herrera in Mexico, is remarkable in that it lives on leaves; other species of the genus inhabit trunks or branches. It was found on the dead leaves of *Yucca*. A new species of *Stagonopsis* on *Zinnia* leaves is also described. A. L. S.

Dominican Fungi.—R. CIFERRI y R. G. FRAGOSO ("Hongos parásitos y saproptos de la Republica Dominicana (6. Sér.)," *Tom. cit.*, 330–41, 11 figs.). A list of fungi from the W. Indies with descriptions of new species and biological notes. The illustrations are numerous and clear. A. L. S.

Fungus Parasitic on a Moss.—R. G. FRAGOSO ("Metasphaeria *Casaresiana* sp. nov. sobre *Barbula fallax*," *Tom. cit.*, 367–8, 2 text-figs.). The perithecia of the pyrenomycetous fungus were abundant on the leaves and stalks of the moss *Barbula*. Fragoso compares it with other moss parasites, and gives reasons for the above determination. A. L. S.

Cave-fungi in America.—J. MAHEU ("La Mycologie obscuricole souterraine Americaine," *Bull. Soc. Mycol. Fr.*, 1926, 42, 130–8). The places examined were the grottoes of City-cave, Kentucky. Maheu gives results from Mammoth cave, Great Onyx Cave, and Colossal cavern. Chiefly it is the mycelial form of any fungus that predominates—mostly *Ozonium* spp., *Byssus* and *Rhizomorpha*. In America the flora is less rich than the similar European cave-flora in species and individuals. But the colours retain more brilliant hues. The larger number remain sterile, and various unusual or imperfect growths are produced. Maheu gives a list of all the forms determined. A. L. S.

Spore-Inheritance.—W. F. HANNA ("The Inheritance of Spore size in *Coprinus sterquilinus*," *Trans. Brit. Mycol. Soc.*, 1926, 11, 219–38, 2 text-figs.). The spores of any grown species of Hymenomycete vary considerably in size. Hanna has selected long and short spores and grown them with the object of seeing if he could get strains either of large-spored or short-spored *Coprinus*. The experiment

proved that this was not possible: individual variations in spore size were evidently not an inheritance character. Similar results are quoted from other workers in the same field of spore inheritance. Hanna found also that there was considerable variation in the mean length of the spore at different times of spore-discharge—and also that small pilei produced smaller spores than those of normal size. The spores experimented with varied in length from $23.3\ \mu$ to $10.7\ \mu$. The very largest and smallest did not germinate. Hanna found also that the presence of bacteria was not necessary to germination.

A. L. S.

Studies in Entomogenous Fungi.—T. PETCH. X. *Verticillium*. (*Trans. Brit. Mycol. Soc.*, 1926, 11, 251-4, 1 text-fig.). The *Verticillium* species which forms the subject of the above study is parasitic on *Aleyrodes* of *Citrus*, and was first observed in Florida in 1905, when it was identified as *Verticillium heterocladium* Penzig. It is peculiar in that it forms superficial stromata which are cinnamon—then ashy-brown coloured. Each stroma covers a single insect. Petch has examined the literature concerning this fungus, and records the results of the various workers on the subject.

XI. *Empusa Lecanii* Zimm. (*Tom. cit.*, 254-8, 1 text-fig.). This fungus attacks the green bug *Lecanium viride* in Java. Specimens of a similar fungus from various parts of India were examined and are here described by Petch, who considers it as probably the same species.

A. L. S.

Entomogenous Fungi: Additions and Corrections, II.—T. PETCH (*Tom. cit.*, 258-66, 1 text-fig.). A large number of fungi parasitic on insects are here recorded and described. Twelve species are considered by Petch as new to science. A number of species recorded by other works are discussed, several of them of doubtful position.

A. L. S.

Poisoning from Dried Fungi.—J. MAHEU ("Deux expertises relatives à des empoisonnements par champignons secs," *Bull. Soc. Mycol., France*, 1926, 42, 139-41). Cases of poisoning having been traced to the eating of desiccated fungi, samples of the material were examined by Maheu. The sample was composed of *Boletus edulis*, but mixed with that fungus were found fragments of other Hymenomycetes; possibly portions of *Amanita* or *Russula*. The lack of precision in the data supplied, as to the collection of the fungi and as to the effect of the poison, made it impossible to give an authoritative decision on the subject.

A. L. S.

Toxicity of *Amanita citrina*.—E. CHAUVIN ("Sur la prétendue toxicité d'*Amanita citrina*," *Tom. cit.*, 196). In a short note, Chauvin calls attention to statements that *A. citrina* is a poisonous plant. It may be so, he allows, when injected into rabbits, which are susceptible animals, but to man it is harmless and may be eaten with impunity. It is not, however, very palatable, and cannot be recommended as edible.

A. L. S.

Study of Tobacco Mosaic.—G. K. K. LINK, P. M. JONES and W. H. TALIAFERRO ("Possible Etiological Role of *Plasmodiophora Tabaci* in Tobacco Mosaic," *Bot. Gaz.*, 1926, 82, 403-14). Discoveries have been made recently of *Plasmodiophora Tabaci* on tobacco plants affected with mosaic disease, and flagellate and amœboid bodies have been found in the mesophyll cells of tomato plants suffering from mosaic disease. The research now described was undertaken to test the constancy of the connection between etiolated plants and the mycetozoan organism. The authors found that *Plasmodiophora* was frequently present on the surface of healthy as well as diseased plants, and that inoculation of tobacco plants

with cultures containing stages of the *Plasmodiophora* produced mosaic only when taken from diseased plants. In such cases there might have been a concomitant mosaic virus. Cultures from diseased leaves, they found, might not contain *Plasmodiophora*, and yet induce mosaic on inoculation. Filtrates from diseased leaves are infective, but do not show the *Plasmodiophora* after standing for various lengths of time. *P. Tabaci* in the plasmodial stage does not pass the filters.

A. L. S.

Melon Parasite.—G. NICOLAS and P. DOP ("Un parasite du Melon de Malabar," *Bull. Soc. Mycol., France*, 1926, 42, 194-5). This Melon, *Cucurbita ficifolia* was attacked by a fungus which dotted the leaves with small black points and finally destroyed them: the parasite was recognized as *Epicoccum nigrum*, usually a saprophyte. The melon was cultivated near Toulouse, and suffered in production partly owing to the presence of the fungus.

A. L. S.

Note on Botryodiplodia sp. on Choisya ternata in England.—R. C. WOODWARD (*Trans. Brit. Mycol. Soc.*, 1926, 11, 281-3, 3 text-figs.). The fungus was causing a die-back of the extremities of twigs of *Choisya* at Wisley, and also at Cambridge. It was finally recognized as *Botryodiplodea Theobromæ*, or allied to that species; it was easily cultured, and when a healthy shrub was inoculated, ten out of twelve inoculations were successful. The fungus is rather common in the tropics on many hosts, and has been recorded under many names.

A. L. S.

Die-back Disease of Pines.—J. S. L. WALDIE (*Trans. Roy. Scot. Arbor. Soc.*, 1926, 40, 120-5, 3 pls.). Austrian pine was at one time considered to be remarkably free from disease, but in this country it is now attacked by several fungal parasites; the most destructive is the pycnidial fungus *Brunchorstia destruens*, which is widely spread in the United States as also in Europe. In this country it occurs not only in the wettest areas of the west of Scotland but also in the dry areas of East Anglia. The leaves and the branches are attacked, and where the disease is severe the tree may be killed in a few years. Its appearance on the tree is described and the gradual spread of the disease. The pycnidia begin to develop in autumn and are mature in April or May. The conidia are elongate fusiform and curved, colourless, and usually four-celled. It has been suggested that this *Brunchorstia* may be a stage in the life cycle of *Cenangium Abietis*, but that matter is not definitely settled.

A. L. S.

Die-back Fungus of Apple Branches.—E. A. SOUTHER and T. F. BROOKS. ("Notes on a Pycnidial Fungus associated with a Dying-back of Apple Branches)," *Trans. Brit. Mycol. Soc.*, 1926, 11, 213-9, 7 text-figs.). The disease was found to be causing the death of large and small branches of apple-trees at Meldreth, Cambridgeshire. A minute pycnidial fungus was found associated with the disease which has been provisionally named *Cytospora fructorum*, a species recorded on fruits of *Pyrus* in Belgium. Cultures were made, and the methods of spore germination were observed. It is peculiar in that secondary spores are budded off from one end of the pycnospor. In the cultures, small rod-like spores were produced which have not been found in nature. Inoculation experiments on healthy trees were unsuccessful, and it is concluded that the parasite can only infect when the tree has already been weakened from some other cause.

A. L. S.

Life-History of a Fungus parasitic on Antirrhinum majus, with some remarks on the Genus Heterosphaeria.—W. E. BUDDIN and E. M. WAKEFIELD (*Trans. Brit. Mycol. Soc.*, 1926, 11, 169-86, 8 text-figs.; *Supplementary Note*, 186-8). The authors present a careful account of a leaf-disease of *Antirrhinum*s.

which is disfiguring and very destructive. It was at first described as *Cercospora* sp., but as that has been proved to be only a stage of a further development of the pycnidial form it is now classified as *Heteropatella Antirrhini*. The ascigerous fruit has not been found, but it may prove to be a species of *Heterosphaeria*. Cultures and inoculations proving the identity of the forms found are described, and the questions of relationship are very fully discussed. A. L. S.

Disease of Sorghum.—E. W. MASON ("On two species of *Tolysporium* Woronin, recorded on cultivated *Sorghum*," *Tom. cit.*, 284-6). The fungus known as the long smut of *Sorghum* and recorded as *Tolysporium Ehrenbergii*, or *T. filiferum*, is stated by Mason to be *Cerebella Sorghi-vulgaris* Subrani. Mason has gone into the question of nomenclature and of the fungal characters. A. L. S.

Lichens.

Bipolar Lichens.—G. E. DU RIETZ ("Den subantarktiska florans bipolara element i lichenologisk belysning," *Svensk. Bot. Tidsk.*, 1926, 20, 299-303). A review by the author of similar or allied species from the two poles. Among these may be noted *Cladonia rangiferina*, a cosmopolitan species, *Cetraria islandica* and others. The writer discusses the methods of distribution of these widely diffused species and their occurrence at intermediate stations, such as the Himalayas. A. L. S.

Ramalina Species.—G. E. DU RIETZ ("Morfologi och systematik hos eläket Ramalina, särskiet dess skandinaviska arter," *Tom. cit.*, 295-8). Du Rietz has published a review of Scandinavian *Ramalinae* and a key to the species based on morphological characters:—on the structure of the medulla, on the occurrence and position of soredia, etc. A. L. S.

Lichens of Mount Everest.—ROBERT PAULSON (*Journ. Bot.*, 1925, 63, 180-93). A small collection of lichens was brought from Mt. Everest by Dr. T. Howard Somervelle. They had been collected in the vicinity of the route followed by the explorers, and above 14,000 ft. There were few to be found above 17,000 ft. Paulson has determined 31 species, and he has collated and compared them with those collected by Sir Joseph Hooker, in Sikkim, in 1869. There are a number of species common to both collections, and a number also common to the Arctic lichen flora. The lichens were in healthy condition and the gonidia growing and sporulating. A rare species, *Letharia flexuosa* was collected, and two new species were described. A. L. S.

Malayan Lichens.—R. PAULSON ("H. O. Forbes's Malayan Plants: Lichenes," *Journ. Bot.*, 1926, 63, 139-42, 1 text-fig.). The plants were collected in Sumatra and Timor; most of them had already been recorded, but there is one striking new species, *Anzia Forbesiana*, distinguished by the thick hypothallic cushion of tangled hyphæ and by the long rhizoids which traverse the cushion. A. L. S.

Lichen Associations in Poland.—J. MOTYKA ("Zespoły roślin w Tatrach. Część II. Naskalne zespoły porostów mitrofilnych w polskiej części Tatr Zachodnich.—Die Pflanzen assoziationen des Tatra-Gebirges. II. Teil: Die epilitheschen Assoziationen der nitrophilen Flechten in Polnischen Teile der Westtatra," *Bull. Acad. Pol. Sci. and Lettres. Cl. Sci. Math. Nat., Sér. B., Sci. Nat.*, 1924, 835-50, 1 pl.). The above paper is a contribution to a general work on ecology. Motyka has selected for this particular examination the rocks of the Tatra, where birds and

small mammals have rested, their excrement providing a substratum deeply impregnated with nitrogen. As a rule the Tatra consists of elevated valley pasture land, but here and there rocks of limestone, dolomite, and granite emerge, and on these as well as on erratic boulders he finds certain types of lichen growth. The associations he has here determined and listed are: Ass. I. *Ramalinetum strepsilis*—consisting of strongly nitrophilous lichens such as *Ramalina strepsilis*, *Rinodina demissa*, *Xanthoria fallax*, etc., with an outer fringe of less exclusively nitrophilous species. He has listed 25 species in this association. Ass. II. *Candelarielletum vitellinae*, includes an equally numerous list of other species somewhat unstable as to locality: Motyka reckons it is a young association which has developed since the destruction of forests. Ass. III. *Physcietum caesia*, also a numerous aggregate of species of strongly nitrophilous lichens such as *Physcia caesia*, *Lecanora saxicola*, *L. circinnata*, and frequently *Dermato carpon complicatum*. Ass. IV. *Caloplacetum elegantis*, found on the steep faces of chalk and dolomite rocks, also in hollows and grottoes. A feature of this association is the apparent indifference to substratum—either calcareous or siliceous. Motyka suggests that there may be two influences at work: that there are probably two associations, one consisting of xerophilous and nitrophilous species, the other of purely xerophilous forms, viz. *Diploschistes albissimus*, *Lecanora Reuteri*, *L. gypsacea*, and *L. lentigera*, though these are lacking on overhanging surfaces; the question is not yet definitely settled. Where lime-loving lichens appear on one of the granitic rocks, their presence is explained by the probable mixture of lime in the excrements of birds or mammals. Nitrophyly is considered by Motyka to be a biological character; many nitrophilous species are also to be found on trees, or are species of normally corticolous genera such as *Ramalina Physcia*, *Caloplaca*, *Xanthoria*, etc. These genera he holds are exclusively either corticolous or nitrophilous (on rocks). He notes also among nitrophilous lichens that polari-bilocular spored genera are abundant, either with colourless or dark spores.

A. L. S.

Study of Epilithic Lichens.—J. MOTYKA ("Część VI. Studja nad zespołami naskalnych porostów.—Die Pflanzenassoziationen des Tatragebirges, VI. Teil. Studien über epilithischen Flechten gesellschaften," *Tom. cit.*, 1926, 189–227). Motyka presents his paper as merely a preliminary work. He begins by affirming that the occurrence and persistence of certain lichens are due partly to the substratum, partly to environment, or to the presence of certain chemical constituents, as, for instance, nitrogen and phosphorus, to the supply of water and to the orientation of the rock surfaces. The response of certain species to these influences is pointed out, thus *Gyrophora cylindrica* is almost ubiquitous on rocks without lime and exposed to wind, avoiding only shaded or moist situations. The struggle for position between different lichen forms is also noted. A space already occupied by crustaceous species is not easily invaded by *Gyrophora*, as the spores of that species will not germinate on organic material. So that the first colonizers are not easily ousted, and remain as part of the Association. He comments on the difficulty of defining an individual Association. He finds, however, that the "true" members are those which find in the environment the conditions best suited to their development, and therefore cover more ground than the other species. "Strange" species may occur, but they should not be reckoned as members of the Association. Instances are given to illustrate his meaning, and he concludes that lichensociology is an exceptionally fine field for the study of Associations generally.

Motyka delineates 18 Associations on the Tatra rocks. 14 are on siliceous rocks, of which 5 are to be found on dry rocks and 4 in damp localities. The

nitrophilous Associations have already been enumerated; the remaining numbers 15 to 18 inhabit calcicolous rocks. Several new points of interest emerged during the course of his work, notably, the different species that inhabit limestone and dolomite, or lime and marl. On lime, dolomite and marl in the Tatra there are entirely different Associations. The dependence of the lichen species on the substratum becomes very evident in a restricted district such as the Tatra.

A. L. S.

Lichen Drawings.—A. ZAHLBRUCKNER ("Spiegazione delle Tavole Lichenologiche inedite di Abramo Massalongo," *Estratto dal Volume giubilare: "Abramo Massalongo,"* 1824–1924, Verona, 1926, 9 col. pls.). These beautiful plates are published in memory of the distinguished Lichenologist, A. Massalongo. Several species of lichens are figured on each plate, giving the life-size representation of the plants with microscopic details of the fructifications, all of them drawn by Massalongo and hitherto unpublished.

A. L. S.

Austrian Lichens.—A. ZAHLBRUCKNER ("Beiträge zur Flechtenflora Niederösterreichs: VIII," *Verh. Zool.-Bot. Gesell., Wien*, 1926, 76, 76–101). The paper is based on work by Julius Baumgartner and H. Suza. Zahlbruckner takes note of two distinct ecological Associations, one on sandy-grassy soil, a *Cladonia-Parmelia* Association, and another on rock and soil in the Ellender Wald. A large number of species are recorded and described, some of them new to science.

A. L. S.

"Synopsis Lichenum."—G. E. DU RIETZ ("Vorarbeiten zu einer 'Synopsis Lichenum.' I. Die Gattungen *Alectoria*, *Oropogon*, und *Cornicularia*," *Arkiv Bot.*, 1926, 20, 1–43, 2 maps, 2 pls.). It is many years since Nylander gave us the first parts of a comprehensive *Synopsis of Lichens*. Du Rietz has taken up the task, and gives in this first contribution a world-wide account of the genus *Alectoria* with the associated genera *Oropogon* and *Cornicularia*. *Alectoria* is a denizen of northern or higher regions, *Oropogon* is tropical or semi-tropical. *Cornicularia* as a genus has been resuscitated for certain species that have affinities partly with *Alectoria* and partly with *Cetraria*. One species, *C. tristis*, was considered by Nylander to be a species of *Parmelia*. The older specific name is *Cornicularia normanica*.

A. L. S.

Spore Production and Ejaculation in Lichens.—ALFRED HILITZER ("Notes sur la Production et l'Ejaculation des Spores chez le *Solorina saccata* (L.) Ach." *Acta Botanica Bohemica*, 1926, 4, 52–8, 3 text-figs.). Hilitzer has given, from long continued observation, an exact account of fruit development and spore ejaculation in *Solorina saccata*. The apothecium remains covered by the thalline cortical layer for a considerable time, when it finally bursts through the tags of cortex fringe the outer wall. It was determined by Hilitzer that spores were ejaculated when drops of water were sprinkled on the disc, a merely moist atmosphere was not sufficient. There is present a basal cortical layer which gives resistant power, the disc swells up with the moisture, the hymenium contracts, and the spores are shot out from the asci. Ascus production from the same disc may continue for some years; the asci mature in succession, but ejaculation only occurs in wet weather. Estimates are given of the number of asci and the number of spores probably formed during the continuance of the apothecium.

A. L. S.

Siberian Lichens.—V. P. SAVICZ ("Flechten aus Tobolsk (Sibirien), gesammelt von B. U. Gorodkov im Jahre 1915," *Travaux Musée Bot. Acad. Sci. l'Urss.*, 1926, 87–106). Savicz continues here his examination of Siberian lichens.

Previous collections were made by Gorodkov in the neighbourhood of Beresow, the present series were collected further south in Tobolsk. Many species have been added to the previous list, both from the Ural Mountains and from the plains. One new species, *Pertusaria stalactizoides*, has been described (Russian), and more abundant material of former collections has been supplied. A. L. S.

New European Genus.—G. E. DU RIETZ ("Flechtensystematische Studien. VIII. *Erioderma mollissimum* (Samp.) D.R., in Portugal, ein Repräsentant einer für Europa neuen Flechten gattung," *Bot. Not.*, 1926, 339-40). The lichen had been determined by Sampaio as *Lobaria mollissima* n. sp. Du Rietz, finds it identical with *Erioderma Wrightii* var. *limbatum*, but worthy of specific rank. A. L. S.

Cryptotheciaceæ: A Family of Primitive Lichens.—A. LORRAIN SMITH (*Trans. Brit. Mycol. Soc.*, 1926, 11, 189-96, 1 pl.). The lichens included in the new family were found (with one exception) in the collections of the late Dr. Stirton. Only one of these had been published as *Cryptothecia subnidulans* n. sp. The specimens are all tropical or subtropical, and have a smooth crustaceous light coloured thallus. The entirely invisible fruit is deeply embedded below the gonidial zone. The fruiting body consists of an ascus surrounded by a tangled peridium of hyphæ recalling the peridium of the Plectascinæ. These perithecia are scattered unevenly through the thallus. Two genera, *Cryptothecia* and *Stirtonia* have been described, the difference being in the spore characters. The nearest affinity in lichens is with the Mycoporaceæ, in fungi with Myriangiales. The specimens had been collected in Asia (from the Himalayas to Burmah), and in W. Africa. A specimen was also sent by Prof. van der Byl from Berea, Natal. The lichen has escaped the notice of collectors evidently on account of the sterile-seeming crust.

Lecanactis in Brazil.—G. O. A. N. MALME ("Die ein Regnellischen Herbar aufbewahrten Arten der Flechtengattung *Lecanactis* (Eschev.), Wainio," *Arkiv Bot.*, 1926, 20, N. 2, 1-6). Malme remarks that ten species of *Lecanactis* have been recorded from Brazil. One species, *L. insignior* var. *fusca*, was very common on the trunks of deciduous trees, and was the only one that was frequent. A. L. S.

African Lichens.—A. ZAHLBRUCKNER ("Beiträge zur Flora von Afrika. LII. Afrikanische Flechten (Lichenes)," *Engler Botanische Jahrbuch*, 1926, 60, 469-552). The paper sums up the work done on three lichen collections: by Brunnthaler in various districts; by Bruno Schröder, from British East Africa; and by Fincke, in German S.W. Africa. The examination was undertaken by Zahlbruckner and Steiner; after the death of the latter, in 1918, by Zahlbruckner alone. There are a large number of new species, especially of *Parmelia*, to which genus special attention has been given, many well-known European lichens are recorded and many new to science. A. L. S.

Brazil Lichens.—G. O. A. N. MALME ("Lichenes blasteniospori Herbarii Regnelliani," *Arkiv Bot.*, 1926, 20, N. 9, 1-51). Malme, in the course of his study of the *Lichenes blasteniospori*, has taken occasion to criticize and re-arrange the genera as accepted by Zahlbruckner in Engler and Prantl's "Pflanzenfamilien." After an examination of the different systems of nomenclature he finally decides on one family, Teloschistaceæ, with three genera, *Callopisma*, *Xanthoria* and *Teloschistes*. He considers that *Placodium*, though amended and accepted by Wainio, is of too mixed import. *Callopisma* takes precedence over *Caloplaca*, and the section *Blastenia* is redundant. The only familiar *Placodium* he deals with is

Pl. elegans, which now he ranks under *Callopisma elegans*. Malme criticizes to some extent the statement that lichen species are widespread. He questions certain determinations that have supported that opinion: thus for *Teloschistes chrysophthalmus* he finds in Brazil varieties that are quite distinct from the European forms. On the other hand, *Callopisma elegans* differs in no particular. He remarks on the probable great age of lichens. The similarity of species in Africa and in S. America may be due to ancient geological conditions. A key to species of *Callopisma* is given; ten species of the genus are new to science. A. L. S.

Portuguese Lichens.—GONÇALO SAMPAIO ("Novos Materiais para a Lichenologia Portuguesa," *Bot. Soc. Brot.*, 1924, 2 (II. Sér.), 161-79). The list includes 57 species, many of them new to science. Full descriptions of these are given, and many notes are given on others previously known. The lichens recorded are mostly crustaceous. A. L. S.

Microscopic Lichen Drawings.—MAURICE PAUTRE CHOISY. ("Collection de Micrographies Lichéniques," Lyon, 1927). Owing to the expense of printing, etc., Choisy has issued this collection in loose multigraphed sheets, with microscopic drawings and descriptions of authoritative specimens from published sets. Fascicles are to be issued year by year, and Choisy claims that this will be the most complete presentation of lichen drawings (microscopic only).

Mycetozoa.

Polish Myxomycetes.—F. X. SKUPIENSKI ("Contributions à l'étude des Myxomycètes en Pologne," *Bull. Soc. Mycol., France*, 1926, 42, 142-69, 4 figs., 1 pl.). The author begins by insisting on the importance of each country preparing a monograph of these organisms that grow on its own territory. He further demands an exact knowledge of their life-histories and development from any students who propose to prepare such a monograph. He recommends his own method of continual culture under observation. Many details are given of these cultures: the nature of the substratum, the effect of external conditions, such as the stage of decomposition of the substratum, the degrees of humidity and shade, etc. Skupiencki then sets out in detail an account of ten different species, in which is given considerable space to the comparison of species and forms with their allies. A. L. S.

Myxobacteria of Poland.—H. I. S. KRZEMIENIEWSKY (*Acta Soc. Bot., Poloniae*, 1926, 4, 1-54, 5 pls.; Polish with German Résumé). The study of these organisms was made in the laboratory by keeping parcels of soil and of rabbit dung, etc., in suitable conditions of moisture and warmth. The soil yielded by far the largest number of species. The author has followed Jahn's monograph throughout, her own descriptions are full and give the details of development, form, size, etc. She has determined 43 species, three of which are new to science, as are also three varieties. Most of the species had been already recorded from Europe, but five were found that were previously only known from America. The plates contain 460 figures (photographic), and there is a complete bibliography of the subject. A. L. S.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY,
DECEMBER 15TH, 1926, DR. JAMES A. MURRAY, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The nomination papers were read of four Candidates for Fellowship.

New Fellows.—The following were elected as Ordinary Fellows of the Society :—

Mr. Claud McClellan Bottomley, B.Sc.

Mr. Ernest Bridgstock Choat, F.Z.S.

Dr. James E. McCartney, M.D., Ch.B., D.Sc.

Donations were reported from :—

American Journal of Hygiene,

“Researches on Hookworm in China.” (Cort, Stoll and others.)

Det Norske Videnskaps-Akademi, Oslo,

“Norwegian Mountain Algæ.”

Votes of thanks were accorded to the donors.

The List of Fellows nominated for Election in January as Officers and Members of the Council was read.

The following papers were read and discussed :—

Mr. Conrad Beck, C.B.E., F.R.M.S.

“A Method of Testing Zonal Aberration.”

Mr. Stanley Hirst, F.L.S., F.Z.S.

“Note on the Development of *Allothrombium fuliginosum* Hermann.”

(Read by Mr. C. D. Soar.)

Mr. A. Kefalas, M.A., M.B., Ch.B., F.R.M.S.

“A Method of Staining Sections in Acetone.”

Captain J. Ramsbottom, O.B.E., M.A., F.L.S., and Mr. E. H. Ellis,
F.R.M.S.

“Seedling Structure of Cultivated Orchids.”

Votes of thanks were accorded to the authors of the above papers and to Mr. Soar.

The business proceedings then terminated.

THE ANNUAL MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY,
JANUARY 19TH, 1927, DR. JAMES A. MURRAY, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

New Fellows.—The following were elected as Ordinary Fellows of the Society :—

Thomas Castle.
George Edger Church, M.B., Ch.B., L.R.C.S. (Edin.), etc.
Myles Fitzgerald Fallon, M.B., Ch.B., etc.
Sydney Harold Robinson.

The nomination papers were read of two Candidates for Fellowship.

Donations were reported from :—

Messrs. Gaston Doin et Cie,
“Les Societes d’Insectes.” (W. Morton Wheeler.)
Messrs. Longmans, Green & Co.,
“High Vacua.” (G. W. C. Kaye, O.B.E., M.A., D.Sc., etc.)
M. Paul Lechevalier,
“Faune de France.” XIII. Dipteres. (Brachyceres.)
XIV. Dipteres Pupipares.
Optical Convention Report.

Votes of thanks were accorded to the donors.

The Death was announced of :—

Mr. Albert Ashe. Elected 1909.

A vote of sympathy with his relatives was passed.

THE ANNUAL REPORT of the Council for the year 1926 was read as follows :—

FELLOWS.

During the year thirty-one Fellows have been elected. Notifications of the deaths of nine Ordinary Fellows and one Honorary Fellow have been received.

Seventeen Fellows have resigned, twenty-one have been removed from the Roll, and one has been reinstated.

The Deaths reported above were those of :—

Dr. G. P. Bate. Elected 1874.
Dr. A. Dashwood-Howard. Elected 1891.
Professor C. Golgi. Elected Hon. Fellow, 1895.
Mr. J. Hixon Irving. Elected 1924.
Mr. K. L. Matthews. Elected 1925.
Senor D. de Orueta y Duarte. Elected 1897.
Mr. F. J. W. Plaskitt. Elected 1906.
Mr. A. Seymour-Jones. Elected 1918.
Mr. Edward B. Stringer. Elected 1912.

JOURNAL.

Your Council, after much deliberation, has decided to make an alteration in the form of the Journal, and the Part for March, 1927, will appear in the new form, with larger pages.

Your Council has to report that it has received, with very great regret, the resignation of Professor Eyre as Editor of the Journal, owing to the state of his health.

Your Council unanimously passed the following resolution :—

“The Council of the Royal Microscopical Society has received Professor Eyre's letter resigning the Editorship of the Society's Journal with profound regret, and particularly for the reasons of health which compelled him to take the decision. The Council wishes to put on record its great appreciation of his services to the Society and to the Journal during the past thirty years.”

LIBRARY.

During the year one hundred and sixteen volumes have been borrowed from the Library by Fellows of the Society, and two volumes have been specially obtained from Lewis's Library for their use.

Donations for the Library have been received from :—The Akademische Verlagsgesellschaft, American Journal of Hygiene, Messrs. E. Arnold & Co., Messrs. Ballière, Tindall & Cox, Trustees of the British Museum, Senor E. Caballero, Messrs. Chapman & Hall, Ltd., The Clarendon Press, Mr. Holmes Ellis, M. Paul Lechevalier, Messrs. Longmans, Green & Co., Mr. K. I. Marks, The Optical Society, The Pan-Pacific Science Congress, Messrs. Urban & Schwarzenberg.

Special thanks are again due to Mr. Paulson for his services as Librarian during the past year and to Mr. E. H. Ellis who has rendered him valuable assistance.

During the year, a number of volumes have been disposed of and the proceeds will be available for the necessary binding and repair of books.

INSTRUMENTS AND APPARATUS.

During the year there have been six valuable donations to the Society's collection of Instruments and Apparatus ; these are :—

- A No. 1 Powell and Lealand Microscope with Accessories.
- A “Swift” Challenge Binocular Microscope with Accessories.
- A “Swift” Portable Binocular Microscope with Accessories.
- A “Swift” Stephenson Binocular Microscope with Accessories.
- A “Swift” Dissecting Binocular Microscope with Accessories.

the property of Mr. Albert D. Michael, and presented by him to the Society.

And a Ross Radial Microscope presented to the Society by Mr. W. E. Watson Baker and Mr. C. F. Hill.

The preparation of the illustrated catalogue of Instruments and subsidiary appliances in the Society's collection has proved a heavier task than was anticipated, and the Curator, Mr. W. E. Watson Baker, with the co-operation of Mr. Hill and Mr. Disney, is still proceeding with the work. The proof of the section dealing with the Microscopes up to 1800 has been corrected, and is now in the printers' hands. The section dealing with the instruments in the Society's collection after this date is well advanced.

SLIDE CABINET.

Some of the Fellows of the Society are borrowing slides from the Cabinet and appreciating the opportunity of so doing.

During the year, Mr. D. Bryce has been carefully examining and preparing the Rotifera collection of slides presented by Mrs. M. N. Murray for inclusion in the Cabinet. This examination is near completion.

The Tardigrada slides still await someone with the necessary knowledge and willingness to treat these in like manner.

The thanks of the Society are due to Mr. Bryce for his kind help, and also to the Curator, Mr. E. J. Sheppard.

MEETINGS.

The Ordinary Meetings have been well attended, and the papers read have led to interesting discussions.

The Biological Section has maintained its interest as will be seen from the special report which will be submitted.

The Industrial Applications Section has held three meetings during the year, the first dealing with the Microscopy of Pigments and Paints when Professor H. E. Armstrong presided. The second under the chairmanship of Sir Herbert Jackson dealt with the Microscope as a Measuring Instrument, and the third, when Dr. Harold Moore presided, discussed the problems of Metallurgy and the Micro-structural Features of Modern Rustless Steels.

Other meetings of a similar character are contemplated, and will be held as and when opportunities offer themselves.

CONFERENCE AT LIVERPOOL.

Your Council is pleased to announce that an invitation from the Council of the University of Liverpool and the Civic Authorities to hold a Conference at Liverpool on March 29, 30, 31, 1927, has been received by the Society.

This invitation has been cordially accepted, and the work of organization is well in hand.

Preparations are being made for an important Exhibition of Microscopes and Accessories and Laboratory Equipment. Many promises of support from the Trade have been received.

A strong and representative Local Committee has been formed, and it is confidently expected that the results of the Conference will be far reaching and prove of great benefit to the Society, and the study of Microscopy in its wider applications.

The report of the Biological Section was read by Professor R. Ruggles-Gates.

Mr. Maxwell moved, and **Mr. Maurice** seconded: "That the Annual Reports be received and adopted." Carried.

Mr. Blood moved, and **Mr. Scourfield** seconded: "That a very hearty vote of thanks be tendered to the Honorary Officers and Members of the Council for their services during the past year."

Carried unanimously.

Dr. Tierney responded.

THE ELECTION OF OFFICERS AND COUNCIL.

The President appointed Mr. Soar and Mr. Taverner to act as Scrutineers, and afterwards announced the result of the ballot for the Election of Officers and Members of the Council for the ensuing year, as follows :—

President.—James A. Murray, M.D., F.R.S.

Vice-Presidents.—A. Chaston Chapman, F.R.S., F.I.C., F.C.S.; C. Da Fano, M.D., L.D.; J. W. H. Eyre, M.D., M.S., F.R.S. Edin.; The Hon. Sir Charles Parsons, K.C.B., M.A., LL.D., D.Sc., F.R.S.

Treasurer.—Cyril F. Hill, M.Inst.M.M., A.Inst.P.

Secretaries.—Joseph E. Barnard, F.R.S., F.Inst.P.; Clarence Tierney, D.Sc., F.L.S.

Ordinary Members of Council.—S. C. Akehurst; E. W. Bowell, M.A., M.R.C.S., L.R.C.P.; J. G. Bradbury; R. S. Clay, B.A., D.Sc., F.Inst.P., F.Op.S.; W. E. Cooke, M.D., F.R.C.P., D.P.H.; M. T. Denne, O.B.E.; E. H. Ellis; R. Ruggles Gates, Ph.D., F.L.S.; J. C. Mottram, M.D.; A. S. Parkes, B.A., Ph.D.; A. Piney, M.B., Ch.B., M.R.C.P., M.R.C.S.; E. A. Robins.

Librarian.—S. C. Akehurst.

Curator of Instruments.—W. E. Watson Baker, A.Inst.P.

Curator of Slides.—E. J. Sheppard.

Honorary Solicitor.—T. H. Hiscott.

A vote of thanks was accorded to the Scrutineers.

Dr. James A. Murray then delivered the Presidential Address :—

“ Nuclear Degenerations due to Multipolar Mitosis.”

Professor Ruggles Gates moved: “ That the best thanks of this meeting be accorded to Dr. James A. Murray for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society.”

Dr. Bowell seconded the proposal, which was carried by acclamation.

Dr. Murray responded.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY, FEBRUARY 16TH, 1927, DR. JAMES A. MURRAY, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The nomination papers were read of four Candidates for Fellowship.

New Fellows.—The following were elected as Ordinary Fellows of the Society :—

Ernest Heller.
William Hugill, M.Met.

The Death was announced of :—

Mr. H. G. Billingham. Elected 1912.

A vote of sympathy with his relatives was passed.

Donations were reported from :—

American Journal of Hygiene,—

“Researches on Hookworm in China.” (Cort and others.)

Messrs. Jacob Dynwad (Oslo)—

“Norwegian Mountain Algæ.” (Strom.)

Messrs. Macmillan & Co., Ltd.—

“Lens Computing by Trigonometrical Trace.” (Gifford.)

Société Portugaise des Sciences Naturelles—

“Etudes sur les Maladies et les Parasites du Cacoyer.” (de Seabra.)

“Les Mitoses de la Granulosa Atresique dans l’Ovaire de la Lapine.”
(Salazar.)

Carl Zeiss, Ltd.—

The Carl Zeiss Works.

A vote of thanks was accorded to the donors.

The following papers were read and discussed :—

Dr. William E. Cooke, M.D., F.R.C.P., D.P.H., F.R.M.S.—

“The Life History of the Neutrophil Polymorphonuclear Leucocyte.”

Dr. Alan S. Parkes, B.A., Ph.D., F.R.M.S., Dr. F. W. Rogers Brambell,
B.A., D.Sc., Ph.D., and Mr. F. Melville—

“The Effect of X-Ray Sterilisation on the Development of the Accessory
Organs of Reproduction in the Mouse.”

Votes of thanks were accorded to the authors of the above papers.

The business proceedings then terminated.

ANNUAL REPORT OF
THE HON. SECRETARY, BIOLOGICAL SECTION,
ROYAL MICROSCOPICAL SOCIETY.

Last session the Biological section completed the eighteenth year of its activities. The attendance at the various meetings was well sustained and, except for the fact that the May meeting had to be abandoned owing to the General Strike, the session was a very successful one.

Various papers and demonstrations of interest were presented, among which may be mentioned "Sporozoa parasitic in Rotifers," by Mr. S. C. Akehurst; the otolith of a pipe-fish (*Ammodytes tobianus*) *in situ*, and also a section of the entire head of a sand eel, by Mr. M. T. Denne; stained preparations showing bacteria in the tissues and another showing *Zoochlorella* dividing in *Paramecium bursaria*, by Dr. J. A. Murray, F.R.S. Mr. David Bryce described a new rotifer. Mr. D. J. Scourfield gave an account of *Volvox* and its nearest allies, with a demonstration of the various new genera which have been described. Professor Gates exhibited a *Volvox* (probably nearest *V. Merrilli*) from the Amazon, and gave an account of the genus *Trichophilus* and other algæ which grow on the long hairs of the sloth in South America, from material which he collected in the Amazon region. Dr. A. Subba Rau discussed the early development of some South Indian Lemurs, with lantern slide illustrations and sections, and exhibited preparations of the eggs of the Lemur, *Loris gracilis*. Dr. R. J. Ludford gave a paper on the oocytes and nurse cells of insects, and showed preparations of cleavage in *Ascaris*. Dr. C. Tierney communicated and discussed a paper by Mr. F. Carrel on the bacteria of Lake Leman, Dr. E. W. Bowell exhibited the radula of *Umbrella mediterranea*, and Mr. W. R. I. Cook gave a demonstration and lantern account of some uncommon fungus root-parasites.

These and other demonstrations were accompanied by lively discussions which added greatly to the interest of the meetings. It was decided to discontinue the visits of the section to "places of interest," as it was difficult for members to attend, and these excursions did not contribute directly to the work of the Society. That work has been well sustained, however, by the interest shown in the programmes of the monthly meetings.

R. RUGGLES GATES, *Hon. Secretary.*

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1927.

TRANSACTIONS OF THE SOCIETY.

IV.—THE EFFECT OF X-RAY STERILIZATION ON THE
DEVELOPMENT OF THE ACCESSORY ORGANS OF REPRO-
DUCTION IN THE MOUSE. PARTS I. AND II.

By ALAN S. PARKES, Beit Memorial Research Fellow, and
F. W. ROGERS BRAMBELL, Fellow of the International Education Board.

(From the Department of Physiology and Biochemistry, and the
Department of Anatomy, University College, London.)

(Read February 16, 1927.)

THREE PLATES.

PART I.

INTRODUCTION.

SINCE castration of either sex at an early age completely inhibits the further development of the accessory organs of reproduction, it must be concluded that the stimuli necessary for their development are produced by the gonads. Further, since transplantation of the gonads does not interfere with the development of the organs, it may also be concluded that the required stimulus is of a hormonal rather than of a nervous nature. The question, however, of what particular portion of the gonad is responsible for the elaboration of the hormone governing the development of the secondary sexual characters and the accessory organs of reproduction is less easy to answer. In the male the testis is readily divisible into semeniferous tubules and inter-tubular tissue, the latter consisting of connective tissue and the so-called "interstitial" cells. The constitution of the ovary is more complex, but even so it is possible to distinguish between the structures

concerned in the maturation of the ova, the follicles, and the extra-follicular tissue.

The original issue, therefore, centred round the question of whether the hormone responsible for the development of the accessory organs of reproduction and the secondary sexual characters was elaborated in the portion of the gonads immediately associated with the production of gametes, or with other gonad tissue. In the male various means may be found to cause partial or even entire degeneration of the spermatid tubules without apparently damaging the intertubular elements, so that in this sex it is not so difficult to differentiate between the two as regards the site of origin of the hormone. The ovary, however, presented a more difficult problem, as it appears impracticable to eliminate the follicles by any operative measure without removing the entire ovary. The discovery, however, some twenty years ago, that exposure to X-rays would destroy the germ-producing structures of both ovary and testis provided an invaluable technique for differentiating between the elements of both gonads.

In studying the correlation between the gonads and the secondary characters and accessory organs two general types of experiment are possible. In the first place it is possible to remove the gonads of the adult animal and observe the effects on the accessory organs, and secondly, it is possible to remove the gonads before puberty and to observe the effects on the development of the accessory organs. The performance of such gonadectomies has shown that the gonad is initially necessary for the development of the accessory organs and further that the gonad is necessary after puberty for what may be called the maintenance of the organs.

In the same way the results of eliminating the germ-cell producing portions of the gonads could be studied either by sterilizing the adult animal and observing any castration changes in the accessory organs or by sterilizing the young animal and ascertaining whether any inhibition of development of the accessory organs suggestive of gonadectomy effect occurs. As in the case of gonadectomy the latter type of experiment must be considered to provide the more searching test.

Many papers have been published dealing with the effects on the accessory organs of X-ray sterilization, but almost without exception these deal with the irradiation of the adult, in which castration changes are less easy to detect than in the young animal. The experiments described in the present paper were performed for the purpose of ascertaining whether or not any gonadectomy effects followed sterilization of the young animal, and to this end young mice were irradiated at weaning time (three weeks old), at birth, and even before birth. Some little time elapsed before a dosage suitable for the object in view was arrived at, but finally a dosage was worked out for the post-natal young which almost invariably resulted in sterility. The histological changes which take place in the gonad after irradiation have been studied in some detail in conjunction with Miss Una Fielding (1927). In the case of the female it was found that early

sterilization did not in most cases inhibit the occurrence of the cestrous cycle subsequent to the attainment of puberty (Parkes 1926, 1927). The present paper is concerned exclusively with the effects of early sterilization on the development of the accessory organs of reproduction.

The mouse colony from which the experimental animals were drawn was maintained partly with the aid of a grant from the Ministry of Agriculture and Fisheries and partly with the aid of a grant from the Royal Society.

PART II.

STERILIZATION OF THE YOUNG FEMALE.

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|-----------------------------------|-------------------------------------|
| 1. Previous work. | 4. Development of accessory organs. |
| 2. Methods and Materials. | 5. Discussion. |
| 3. Histological effects on ovary. | 6. Summary. |

1. *Previous Work.*

The sterilizing effects of exposure to X-rays were first demonstrated on the testis, but shortly afterwards work was extended to the ovary. Halberstädter (1905) was apparently the first author to record changes in the ovary following irradiation. Further work by various authors, reference to whom is made by Colwell and Russ (1924), showed that complete obliteration of the Graafian follicles could be produced by irradiation, without injury to the inter-follicular tissue. The latter, indeed, was found to hypertrophy in most cases. As a result of the changes taking place in the ovary after irradiation Bouin, Ancel and Villemin (1906) found marked atrophy on the part of the uterus, vagina, clitoris, and mammary glands, and concluded that this was due to lack of corpus luteum tissue. Since all these organs develop in the absence of luteal tissue, however, this seems to be an untenable conclusion and the authors subsequently abandoned the view. More important from the physiological point of view are the experiments of Steinach and Holzkecht (1916). These authors irradiated young guinea pigs and produced the usual follicular degeneration and hypertrophy of what they call the interstitial tissue, which appears to be analogous to what is termed the first proliferation in the description by Brambell, Parkes and Fielding (1927). Some two months later this was found to have been followed by hypertrophy of the mammary glands, and by the assumption on the part of the uterus of features characteristic of pregnancy. By suitable controls it was found that this effect was not due to the direct action of the rays on the organs themselves.

2. *Methods and Materials.*

Material.—Three sets of animals are available for description here, i.e. females sterilized before birth, at birth, and at weaning time. The first operation consisted in exposing the pregnant mother, a procedure which naturally tended to produce uneven results. In nearly every case it was

found that some of the litter were sterilized, while others were only partially affected. This variation in results made it impossible to say *a priori* that any given animal would be sterile and made it necessary to consider the sterility of each animal separately. The young irradiated at weaning time presented a much easier problem, and a dose was eventually arrived at which sterilized the young with uniformity. In all cases, however, in both pre-natal and post-natal experiments two criteria of sterility were applied to every animal: (1) initial incapacity to breed, and (2) histological absence of oocytes and follicles.

The dosages found necessary to sterilize the animals with the apparatus used are described elsewhere in the report of the oestrous cycle after sterilization (Parkes (1926)).

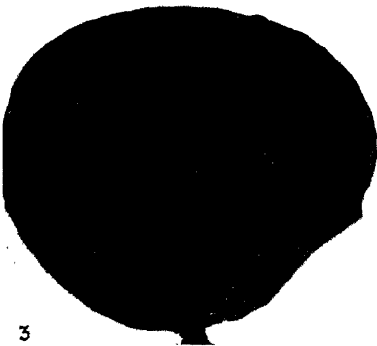
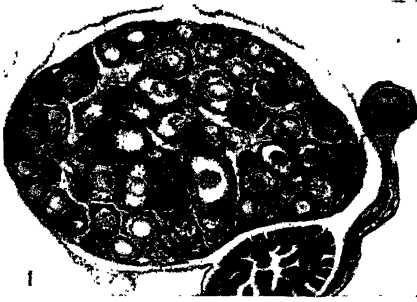
3. *Histological Effects on the Ovary.*

As is mentioned above the changes taking place in the irradiated ovary form the subject of detailed collaboration papers, but a very brief account may, however, be given here. Irradiation is followed immediately by the disappearance of small oocytes and by the growth and degenerative segmentation of the older oocytes. This is eventually followed by the degeneration and disappearance of the cells of the follicles. During the later stages of follicle disintegration a new growth coming from the germinal epithelium invades the cortical tissue. Within a few weeks of irradiation this new tissue comes to form practically the whole of the ovary. The new tissue is arranged in cords, and in many cases the cells become more or less markedly luteal in nature. In many of the ovaries this invasion is followed by a second proliferation from the germinal epithelium in the form of more or less spherical cords.

A typical ovary taken from an adult animal sterilized at three weeks old is shown in Plate IX, fig. 3, beside figures of the normal mouse ovary at three weeks old when the irradiation is performed, and of the normal adult mouse ovary. In Plate IX, fig. 4, is shown a section of an ovary from an adult mouse which was sterilized two days before birth. It will be noticed that the general condition is not dissimilar.

EXPLANATION OF PLATE IX.

- Fig. 1.*—Ovary of normal mouse at three weeks old, showing large number of immature follicles. $\times 60$.
Fig. 2.—Ovary of normal adult mouse, showing numbers of mature follicles, immature follicles, and a few atretic follicles. $\times 40$.
Fig. 3.—Ovary of mouse irradiated at three weeks old and killed when adult seven weeks later. Follicles as organized units are entirely absent, and the body of the ovary consists almost exclusively of tissue of the first post-irradiation proliferation. $\times 60$.
Fig. 4.—Ovary of mouse sterilized before birth and killed at ten weeks old. In this case even the cavities representing the original location of the follicles have almost disappeared. $\times 100$.
Fig. 5.—Uterus of normal mouse at three weeks old, showing general immature appearance and lack of stromal glands. $\times 100$.
Fig. 6.—Uterus of normal adult mouse. $\times 50$.



4. Development of Accessory Organs.

Uterus.—At three weeks old the uterus of the normal mouse is about 0.05 cms. in diameter, and, though consisting of essentially the same elements as the adult uterus, is clearly distinguishable, quite apart from its small size, by the rudimentary nature of the glands in the stroma and by the lack of development of the muscular layer (Plate IX, fig. 5). When puberty is reached at eight weeks old, however, the uterus has increased markedly in diameter (about 0.2 cms. in the dioestrous state) and the differentiation is complete. The muscle layers, running both longitudinally and circularly, have become well developed, and numerous glands are present in the stroma. The uterine epithelium, however, is still one cell thick during dioestrus but an increase takes place at certain stages of the oestrous cycle (Plate IX, fig. 6). That this development is due to stimulus from the ovary is quite evident when the uterus of the adult mouse ovariectomized at three weeks old (Plate X, fig. 7) is considered. In this case the uterus of the adult mouse is not only not developed from the condition at three weeks old, but has even degenerated from the pre-puberty state. The stroma is, of course, entirely devoid of glands, and is in fact rarely more than four cells thick as compared with the comparatively extensive stroma of the normal uterus at weaning time. Uterine epithelium appears to be almost absent in the female ovariectomized at three weeks old.

Attention may now be turned to the effect of early X-ray sterilization on the development of the uterus. It must be admitted at once that the results are somewhat confusing, and this confusion was quite in accordance with the brief resumé of the literature given above. Since a very large amount of material has, however, been accumulated, the data have at last been reduced to order. The types of uteri found in sterilized animals may be classified as follows :—

(1) *Normal Uteri.*—By far the largest number of animals whether sterilized at or before birth or at weaning time, have, when they subsequently become adult, uteri which in all respects are indistinguishable from those of normal animals. As reported elsewhere (Parkes 1926) the uteri and vaginae in these animals go through the normal periodic changes characteristic of the oestrous cycle. This type is associated with what we have come to consider the normal type of sterilized ovary, which is found in nearly all cases after irradiation at weaning time and in the majority of cases after irradiation at birth. This type of ovary is figured in Plate IX, fig. 3, and it must be supposed that it elaborates the hormone responsible for the development of the accessory organs in the first place and also at a later date the oestrus producing hormone.

(2) *Infantile Uteri.*—In several cases adults which had been sterilized at birth were found to possess definitely infantile uteri, such as are found in the normal mouse at about three or four weeks old. One such abnormally

infantile uterus is figured in Plate X, fig. 9. It will be seen that this is almost identical with the normal uterus at three weeks old. This, though not quite a complete castration effect, obviously closely approaches it. These cases, which only occurred in the mice sterilized at birth, were found to occur in conjunction with gross fatness of the mesenteries and with a peculiar type of ovary. These ovaries, described elsewhere (Brambell, Parkes & Fielding (1927)), were found to consist entirely of first post-irradiation proliferation tissue which had lost its normal nature and which had become very luteal like. Since these animals, in addition to having abnormal uteri, failed to show an oestrous cycle, it must be concluded that this abnormal transformation in the sterilized ovary had taken place at an early date, and had first failed to produce the development of the uterus and subsequently prevented the appearance of oestrus. (For further discussion relating to the oestrous cycle see Parkes (1926).)

(3) *Retrogressive Uteri*.—In a few cases uteri were found which had the appearance of being retrogressive from a former state of development, namely, they had the appearance which is found soon after ovariectomy performed at or just before puberty. These animals, with one or two exceptions, showed oestrous phenomena only in the early part of their adult life, the cycle not being maintained for any length of time. Examinations of the ovaries of these animals show in no case the ordinary type of sterilized gonad. In all cases either the first proliferation had become very luteal like, except in one instance (M. 6e) sterilized at weaning time, where the tubular second proliferation, to which we have been unable to trace any endocrine activity, had come to form the whole ovary.

(4) *Hypertrophied Uteri*.—The fourth and last type of uterus which is found in these animals is characterised by hypertrophy of the stroma and lumen (Plate X, fig. 10). This condition has been figured by other authors (see above) and by them has been considered to be due to hypertrophy of the interstitial tissue of the ovary. In our own material, however, it is found to be associated with a certain amount of luteal tissue originating apparently from the first proliferation in the ovary and with irregularities of the oestrous cycle. The most probable explanation of these cases, which are definitely not the usual condition of material irradiated as ours was, is that luteal tissue

EXPLANATION OF PLATE X.

Fig. 7.—Uterus of mouse ovariectomized at three weeks old, showing severe ovariectomy atrophy. $\times 200$.

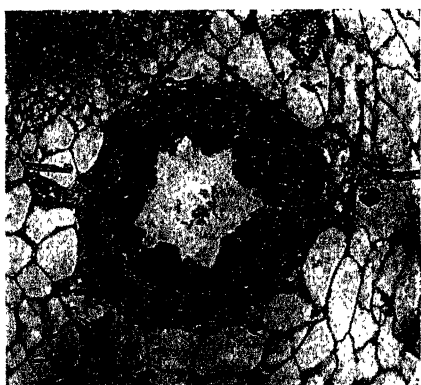
Fig. 8.—Uterus of mouse irradiated at three weeks old and killed at ten weeks. Uterus is perfectly normal and shows no signs of ovariectomy effects. $\times 50$.

Fig. 9.—Uterus of mouse with ovary changed to luteal-like tissue after irradiation, showing approach to ovariectomy inhibition. $\times 100$.

Fig. 10.—Uterus from mouse with ovary showing late development of luteal-like tissue. In this case the convolution of epithelium and lumen is in some degree reminiscent of pseudo-pregnancy. $\times 700$.

Fig. 11.—Vagina from mouse at three weeks old, showing general immature condition. $\times 40$.

Fig. 12.—Vagina from normal adult mouse in oestrus, showing convolutions of the lumen lined with cornified epithelium, which is darkly stained. $\times 30$.



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develops either from atretic follicles or from the first proliferation, but not in sufficient quantities to disturb the other endocrine functions of the sterilized ovary, and that this tissue takes on some function analogous to that of the normal corpus luteum and causes the "pseudo-pregnant" condition of the uterus which is found in these cases.

Since, however, the three classes of abnormal uteri together represent but a small proportion of the cases, and since they are associated with aberrations of the sterilized ovary, it is clear that the normal sterilized ovary permits of the normal development of the uteri.

Vagina.—The vagina of the normal mouse at three weeks old is a little over 1 mm. in diameter. As shown in Plate X, fig. 11, the lumen is much involuted and exists largely as a folded slit. The epithelium lining the lumen is 2-3 cells thick, and measures about 20 μ in section. The epithelium is backed by connective tissue which is very vascular round the periphery. Even at this time a certain amount of debris (mucus and a few epithelial cells) is to be found in the lumen, but this does not seem to have any relation to the vaginal contents which are found after puberty and the cyclic changes in which furnish a valuable guide to the oestrous cycle. By the time puberty is reached the vagina has about trebled in diameter, and a thin muscular sheath has become apparent. The state of the epithelium depends on the stage of the oestrous cycle. During oestrus the epithelium becomes thickened and cornified, whereas during diestrus it consists of ordinary nucleated epithelium, 4-5 cells thick.

This pre-puberty development of the vagina is due, as in the case of the uterus, to some stimulus from the ovary, as is shown by considering the case of the vagina from an adult ovariectomized at weaning time. As shown in Plate XI, fig. 13, ovariectomy at three weeks old stops all subsequent development of the vagina and results in degenerative changes. The actual sectional size of the organ is still considerable (about 1.5 mm. in greatest diameter), probably owing to general topographical changes in the region, with the result that the difference in size from the normal adult is nothing like as marked as in the case of the uterus after ovariectomy before puberty, but the tissue degeneration is equally striking. No sign of muscle sheath is visible, the connective tissue is undeveloped and contains cavities, the epithelium is inactive looking and only 1-2 cells thick, while the whole organ is flattened. The narrow lumen is almost completely choked with debris, which, as would be expected from the vaginal smear after ovariectomy, appears to consist of nucleated epithelial cells and leucocytes.

The vagina of the adult sterilized at three weeks old shows no ovariectomy effects whatever, and does in fact possess every characteristic feature of the vagina of the normal adult, showing that as in the case of the uterus, post-pubertal development is not dependent upon the presence of gametogenic tissue.

Clitoris.—It has not been definitely shown that any inhibitory action on the development of the clitoris is brought about by ovariectomy before

maturity is reached, and the illustrations given show pretty clearly as regards the mouse that the normal development of the clitoris takes place after ovariectomy. This is probably due to the fact that the clitoris of the adult mouse is in a very rudimentary state of development and to the corollary that the changes taking place in the clitoris between weaning and puberty are largely merely size changes.

Erectile tissue, the development of which, on analogy with the penis, might reasonably be supposed to be dependent on the presence of the ovaries, appears to be absent in the mouse. The essential features of the normal adult clitoris are to be found in both the clitoris after ovariectomy and after X-ray sterilization at weaning time.

The normal clitoris consists of a mass of connective tissue which is bordered by epidermis containing a large number of skin glands, and in which are embedded the urethra, large ducts, and a "U" shaped strip of tissue representing the clitoral cleft. This last structure is situated between the ducts, and usually partially surrounds the urethra (Plate XI, fig. 16). The distal extremity is cleft ventro-dorsally, and the urethra opens out in this cleft.

The clitoris at three weeks old presents all the same essential features, but the mass of connective tissue is absolutely and relatively less than in the adult (Plate XI, fig. 15). The clitoris of the animal ovariectomized at weaning time (Plate XI, fig. 17) and of the animal sterilized by irradiation at three weeks old are both indistinguishable from the normal.

In the circumstances, therefore, the post-irradiation development of the clitoris cannot be said to present any definite evidence relating to the site of origin of the hormone causing the development of the accessory organs.

5. Discussion.

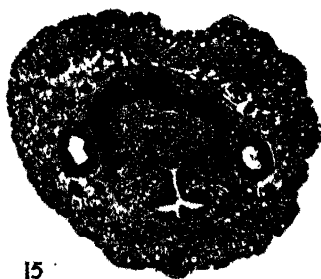
The work described above, taken in conjunction with that of other authors, shows conclusively that the presence of organised follicles is not necessary for the production of the stimulus causing the post-pubertal development of the accessory organs. Since, however, the major portion of the irradiated ovary is composed of tissue of post-irradiation growth, and it is consequently difficult to distinguish old ovarian tissue other than

EXPLANATION OF PLATE XI.

Fig. 13.—Vagina from adult mouse ovariectomized at three weeks old, showing atrophy.
× 40.

Fig. 14.—Vagina from adult mouse sterilized at three weeks old. The mouse was not in oestrus, but no signs of ovariectomy changes are observable in the vagina.
× 35.

Figs. 15-18.—These four illustrations show the mouse clitoris at three weeks old (15), at five months old (16), after ovariectomy at three weeks old (17), and after X-ray sterilization at three weeks old (18). No fundamental structural difference is observable. The immature clitoris is small and the essential structures are present with the large excess of connective tissue found in the adult specimen. Very little difference is observable in the remaining three cases, except that 17 and 18 are less fully grown than the normal case (16). (Magnifications: 50, 25, 35, 35 respectively.)



follicular remains, this generalization does not throw much light on the question of what tissue of the normal ovary produces the requisite hormone.

Doubt has recently been expressed by Allen and Doisy (1924) as to whether there exists a separate ovarian hormone responsible for the development of the accessory organs of reproduction. These authors claim that, since injection of the oestrus producing hormone before puberty leads to hypertrophy of the uterus, the oestrus producing hormone is also responsible for the early pre-pubertal development of the accessory organs. Such an experiment, however, scarcely seems relevant, and they have entirely failed to show that injection of oestrin in the young ovariectomized female can from the earliest time take the place of the ovary as regards the control of the development of the accessory organs of reproduction. There are in fact good reasons to suppose that oestrin is not the factor involved in the early development of the female accessory organs. These may be briefly recorded:—

(1) If the oestrin is elaborated by the ovary during its entire life it is difficult to see why oestrous symptoms do not appear till puberty. It is true that Parkes and Bellerby (1926) found appreciable amounts of oestrin in immature ovaries, but the material could only have been obtained from animals nearing the first oestrus period.

(2) Allen and Doisy's theory that oestrin is necessarily associated with the development of the accessory organs is mutually incompatible with their claim that it is only elaborated by the maturing follicle.

(3) If oestrin is the basic female hormone controlling the development of the accessory organs, as does the internal secretion of the testes, administration of oestrin to the young male should produce abnormalities of sexual differentiation. So far as evidence exists on this point (Parkes and Bellerby (1927)) no such aberration occurs.

(4) Finally, there is the very significant fact that although oestrin will produce all the histological symptoms of oestrus in ovariectomized mice, mating at this time has rarely, in our experience, resulted in copulation. This fact suggests most strongly that oestrin cannot be considered to be the sole agent in the regulation of the sexual instinct.

Since the irradiated ovary produces oestrin this material cannot be used as evidence either way relating to this point. The fact that oestrin has such an immediate and drastic action on the uterus makes it necessary to use some accessory organ or secondary sexual character not violently and suddenly acted upon by oestrin for the study of the effect of oestrin on development. Unfortunately, no such character showing ovariectomy inhibition is to be found in the mouse.

Finally, it may be said that it has been shown conclusively that the gametogenic portions of the ovary are not essential for the development of the accessory organs, but since they are also not essential for the production of the oestrus-producing hormone, no headway has been made in distinguishing

between the hormone responsible for œstrus, and that (if different) responsible for directing the development of the accessory organs of reproduction.

6. *Summary.*

(1) Irradiation of the female mouse results in the total destruction of the follicles and the bulk of the irradiated ovary comes to consist of tissue proliferated from the germinal epithelium.

(2) Even if sterilization is effected earlier than birth, however, no interference is usually caused with the development of the accessory organs—uterus, vagina, clitoris.

(3) In certain mice irradiated immediately after birth, however, the tissue of the ovaries becomes luteal-like. If this occurs early the development of the accessory organs may be inhibited, while late development of the luteal-like tissue may result in the assumption of pseudo-pregnant symptoms by the uterus.

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V.—THE PHOTOMICROGRAPHY OF METALS.

By H. WRIGHTON, B.Met.

(A Communication from the Research Department, Woolwich.)

(Read at the LIVERPOOL CONFERENCE, March, 1927.)

TWO PLATES AND SIX TEXT-FIGURES.

It is probable that in no other branch of microscopical work does photography play so generally important a part as in metallography. Almost all work on the structure of metals is carried out in the laboratories of works or technical institutions where the microscope is only one of a number of methods of testing materials, and the information it gives has to be correlated with the results of chemical, mechanical and pyrometric tests. The metallurgical microscopist is therefore, almost without exception, not an individual working for his own instruction, but one working with the main purpose of putting his evidence forward to be understood by others. As no two metal specimens, or even different fields in the same specimen, look exactly similar, and as it is rare that other experienced workers have the opportunity of visual examination of the specimen, it follows that very great use is made of photomicrographs. It is unusual to-day to find a metallurgical microscope in regular use without some form of photomicrographic apparatus standing alongside.

To the metallurgical microscopist, therefore, the general excellence of his photographs is a matter of great importance, as both the standard of his technique and also the validity of his deductions are judged by other workers from the photographs.

The science of metallurgical microscopy is a comparatively new one. It had its beginning some fifty years ago in the work of Sorby. Sorby himself was a keen microscopist; before attempting to reveal the structure of metals under the microscope he had successfully followed up other branches of microscopical work and had originated the science of petrology. He therefore approached this new field of work with a sound knowledge of the microscope. He did all the preparation of his specimens entirely by hand, a method involving a great amount of time and patience. The micrographs he took are sharp and clear, and show that his specimens were free from scratches and other faults in preparation (Plate XII, fig. 1).

Most of the time and labour he spent in the preparation of his specimens may be eliminated by the use of power-driven grinding and polishing appliances, but these are expensive and take up a good deal of room permanently, and there is little doubt that this is the main reason for the almost complete

neglect of metallurgical work by amateur microscopists ever since Sorby's time.

It is well known that keen amateur microscopists have been largely responsible for the development, both optically and mechanically, of the microscope and of its technique, for all those branches of work in which they have been able to interest themselves, and it is probable that the development and progress of metallurgical microscopy has suffered somewhat through the almost complete absence of such workers.

Examination of the metallurgical photomicrographs published fifteen or twenty years ago in various technical books and journals will show that the general standard at that time left a good deal to be desired; this fact has been noted and adversely commented on at various times by our leading microscopists and opticians. There have been a number of reasons for this state of affairs which it may be of interest to mention.

The work has been almost entirely in the hands of metallurgists who have been compelled by the pressure of purely metallurgical research work to treat the microscope simply as a tool, and have not made a study, or a hobby, of the instrument itself.

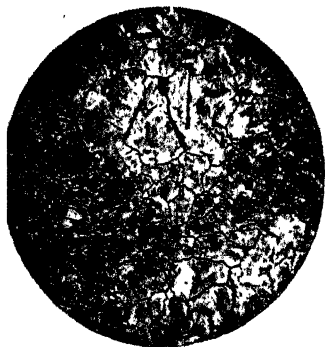
The text-books on metallography have been written by metallurgists, and whilst dealing fully with the interpretation of the structures of metals, have not dealt adequately with the theory of the metallurgical microscope. As a consequence new comers to the work have been without any clear guide to the optics of the instrument.

The sale of metallurgical microscopes and their accessories has always been a very restricted one, therefore the makers (particularly those in this country) have not been able to devote time and money to the development and perfection of apparatus specially for this class of work.

However, the conditions (of fifteen or twenty years ago) are rapidly changing; the general standard of work is now much higher, and some workers, among whom may be noted Lucas, are actually taking a lead in critical high power work. Plate XII, fig. III, is an example of Lucas's recent work with ultra-violet light.

The metallurgical microscope appears to be a very simple affair; it carries nothing, as compared with the elaborate substage illuminating apparatus of a good biological stand, to suggest the necessity for critical control of illumination. This simplicity, coupled with the quite erroneous impression that the etched surface of a metal specimen spreads its reflected light so effectively as to nullify attempts at illumination control, has been responsible for a good deal of neglect of the question. For critical high power work, accurate control of illumination is just as essential as in other branches of microscopy, and in attempting to attain this, it is advantageous to assume that the surface of the metal specimen acts as a perfect reflector, i.e. that the incident illuminating beam will be exactly duplicated in form in the reflected image-forming rays.

In the metallurgical microscope the only illumination control available



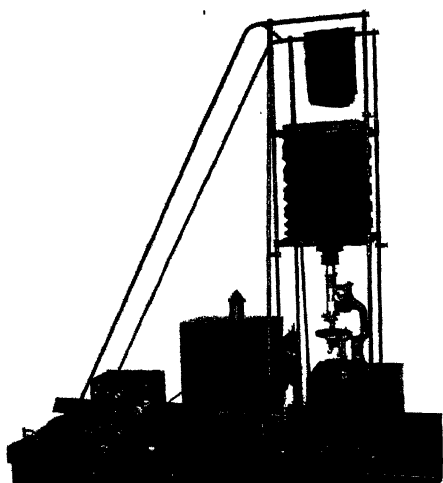
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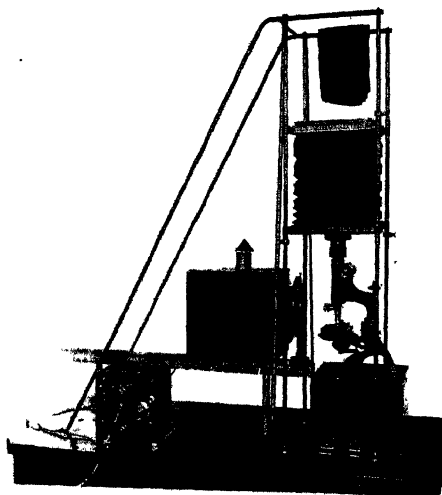
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V

is in the beam of light coming from the illuminant to the instrument. Improper control of this may result in restriction of the cone or pencil of rays necessary for the objective to work at full aperture and full resolution, but in actual practice generally results in the reverse, namely, the introduction into the tube of the microscope and into the objective of a cone of greater angle than is necessary, with the production of flare over the image, blotting out the finer detail. Attempts to eliminate this flare, by restricting the aperture of the objective, by using a pattern of vertical illuminator which, according to its adjustment, either blocks up half the aperture of the objective or fails to give vertical illumination, by over-etching of the specimen, and other expedients, have been, and are still being used, generally with very unsatisfactory results.

The purpose of the substage condenser on a biological microscope is to

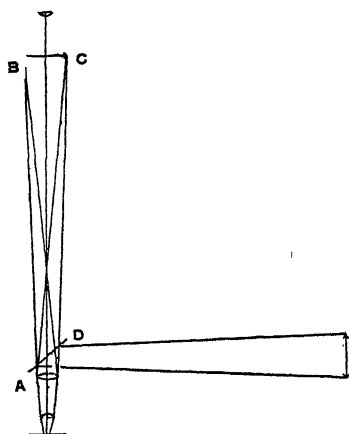


FIG. 1.

bring to a focus, in the plane of the object, a pencil of light of angle or aperture equivalent to that of the objective in use. The metal specimen must be similarly illuminated, but in this case the condenser used for the purpose is the objective itself.

Examination of the paths of the rays in a metallurgical microscope will show (fig. 1), that if the object under examination has a perfectly smooth surface, the real image produced in the microscope at the focus of the ocular will consist of an even disc of light. The ideal light source is a disc of the size of this image, at a distance from the objective equal to that of the image and emitting only a pencil of rays equivalent to that included within the lines A-B, C-D. The distance of this light source from the objective is definitely fixed, for only when it is at the above-mentioned (tube length) distance will the light be brought to a sharp focus on the specimen.

The effects of some modifications of this incident beam are shown in

fig. 2. (For simplicity the vertical illuminator is omitted, the rays being shown as impinging directly on the back lens of the objective.)

In A, the pencil of rays is too narrow angled, and the full aperture and resolution of the objective are not being utilised, owing to its back lens not being filled with light.

B. With a wider-angled cone, stray light is entering the microscope tube, to produce some small amount of flare by reflections therein. This is probably the least harmful variation.

C. The full aperture of the objective is being utilised, but from a source which is too large. That portion of the pencil lying outside the dotted lines is taking no part in image formation, but producing flare.

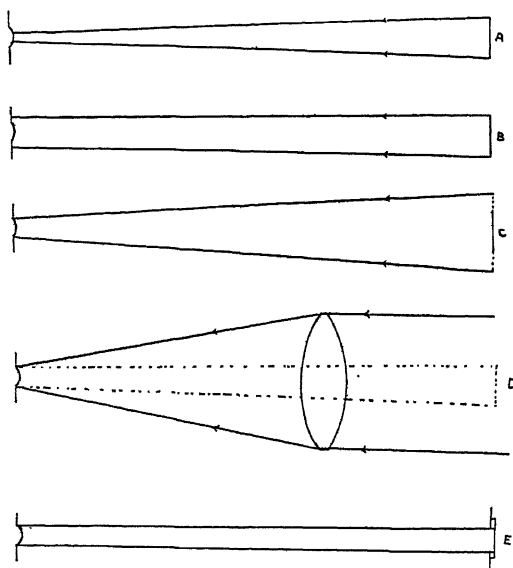


FIG. 2.

D. Similar to C, but very much aggravated. This shows the effect of using a bull's-eye condensing lens of relatively short focus and large diameter in such a position as to bring a spot of light to a sharp focus on the vertical illuminator or back lens of the objective. It will be seen that by far the greater part of the incident light is giving rise to flare only, and in addition, owing to the relatively short focus of the bull's-eye and its close-in position, the light will not be brought properly to a focus on the specimen.

E. The full aperture of the objective is being used, but the light source is small in diameter, and as a consequence only the centre of the field of view of the ocular is illuminated. This is a very useful modification, to which further reference will be made later.

The necessity for bringing an image of the source of light sharply to a focus on the surface of the specimen, and therefore of maintaining the light

source at tube-length distance from the objective, is shown in fig. 3, where A represents the front lens of the objective and BC the surface of the specimen. In order that a spot D in the specimen may be fully resolved by the objective, it is necessary that a complete pencil of rays, represented by DE, DF, be reflected, and the incident rays for providing these by reflection will not be

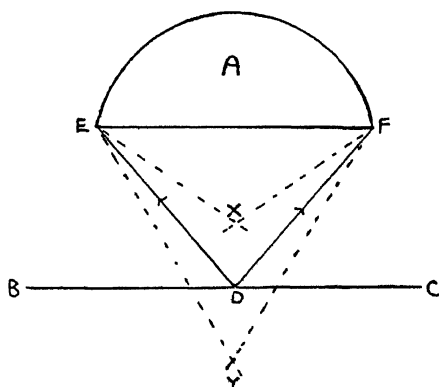


FIG. 3.

present if the light is brought to a focus either at X above, or Y below, the plane of the specimen.

An illuminating system to meet the above requirements may be provided as shown in fig. 4, a lens B being chosen for such focal length that, when placed at tube-length distance from the back of the objective A, a sharp image of the illuminant C may be obtained (by adjusting the position of C), which is of such size as just, and only just, to fill the back lens of the objective. Here, there are two variables, the sizes of A and of C. Probably the most

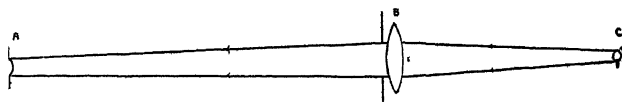


FIG. 4.

satisfactory illuminant is the 100 c.p. Pointolite; it provides a perfectly even disc of light. If a larger source be used, such as the 500 c.p. Pointolite, then in order to bring the size of the image at A down to proper dimensions it is necessary to increase the distance B-C, and the gain in light intensity is thereby nullified. In practice it is desirable to fit a lens at B which just serves to fill the back lens of the highest power objective available, generally the 2 mm. It is when working with this as a rule that the most critical illumination is required. The back lenses of the various foci objectives do vary a little in size, but it will be found generally that, using a lens which just fills the 2 mm., the 4 mm. is almost filled, and the lower power objectives are not nearly so critical, as they have considerably greater apertures than

they really require. The lens B will be found to have a focal length of approximately 3 in. when chosen to adopt the 100 c.p. Pointolite to the 2 mm. objective; this lens must have mounted close to it an iris or other variable diaphragm. The lens acts as the disc light source above described, and the diaphragm is to provide a regulation of its diameter. A feature of the above described illuminating system is its simplicity and the reduction to a minimum of optical components and diaphragms, the difficulties of centration and alignment being thereby very small.

The above illuminating system gives quite sufficient intensity for photographic work, using, of course, the transparent slip type of illuminator. For visual examination it is much too strong unless a very dark colour screen or neutral tint glass be introduced. A simple illuminant for visual work is shown in Plate XII, fig. 11. The lantern contains an ordinary 40 watt metal filament bulb. A piece of finely ground glass acts as the light source to the microscope, its size being regulated by the disc stops mounted on the front. Adjustment for the height of the light from the table is provided. With this illuminant no lens is used, the ground glass disc acting directly as light source to the microscope. The only undesirable rays introduced into the microscope by this lamp are those corresponding to fig. 2, B; this is re-drawn in fig. 5.

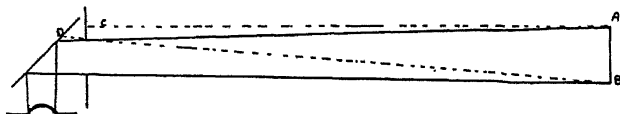


FIG. 5.

The ground glass emits rays in all directions; unwanted rays such as AC may be obstructed by a stop of suitable size on the side of the vertical illuminator box, but other rays as represented by BD cannot be eliminated and give rise to a small amount of flare. The lamp is satisfactory, however, for all except the most critical visual examination.

Returning to consideration of the illuminating system for photographic work as shown in fig. 4, it will always be advantageous to restrict the size of the light disc at B by means of the iris diaphragm, so that only just that circle of the image to be photographed is illuminated, as this adjustment further slightly reduces flare. In critical visual work also it is well to restrict B so that its image just appears within the field of the ocular. This diaphragm at B acts purely as a field stop, and has no effect on the working aperture of the objective.

Working with reasonably good objectives and critical illumination it should seldom be necessary to restrict the aperture of the objective. Some slight gain in apparent flatness of field may be obtained by this means, but the resolving power of the objective is restricted, and further, if the aperture be greatly reduced, false images will be formed. The small iris or other diaphragm which is often fitted to the side of a vertical illuminator cannot

be regarded as a satisfactory aperture control, measured along the light path, its position is about $1\frac{1}{2}$ in. from the back lens of even a short-mounted objective. In this position, by the time it becomes of service in restricting aperture, it is acting as an imperfect field stop also, leaving the centre of the field relatively bright and darkening the borders of the image. The correct position for an aperture control is close to the back lens of the objective, and the new vertical illuminator by Beck carries slot stops as near as possible to this position, and is a distinct improvement. Restriction of aperture, however, is not advisable, except in the interests of sharp focus over a comparatively large field, and when the maximum resolution of the objective is not required.

A very useful accessory is shown in fig. 6. This fits into the draw-tube in place of the ocular; its small central hole of about $\frac{1}{8}$ th diameter is screened only by a piece of dark, flat glass; there is no lens. If, after a specimen has been brought to a sharp focus in the usual manner, the ocular is withdrawn

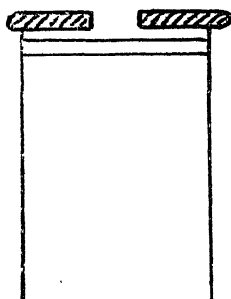


FIG. 6.

and replaced by this fitting, the back lens of the objective may be examined, and a clear idea obtained of the extent to which the aperture of the objective is being utilised, and of the accuracy of centration of the illuminating system.

What has already been said amounts simply to a method of adapting the principles of critical illumination as practised in transmitted light microscopy to the metallurgical microscope. There is, however, in the metallurgical microscope another source of flare and image destruction not met with elsewhere. Owing to the large amount of light which is lost by non-reflection of the incident beam at the vertical illuminator and at the metal surface, and by reflection of the image forming beam at the vertical illuminator, it is necessary to use an incident beam of light which is, relative to the true image-forming beam, exceedingly intense. This incident beam impinges straight on to the back lens of the objective, and some of it is reflected directly from there, straight up the tube into the ocular. The flatter the surface of the back lens, the greater this trouble. The majority of apochromatic objectives have a back lens which is very flat in comparison with the achromats, and owing to this, and to the larger number of glass

surfaces present in their more complex construction, they generally suffer from this type of flare far more than the achromats. There is no essential reason why a series of apochromats should not be computed specially for metallurgical work with a bold curvature on the back lens. Recently a number of 2 mm. apochromats, all quite recent productions of English and Continental makers, have been examined, two of them were very superior to all the others in this respect, and the better of the two was an English one. It is very probable that the computation of most of these objectives has been made without any consideration of this point; recomputation is hampered by the heavy expense and the very small demand.

This flare may be reduced by using a prism or other similar opaque illuminator, but so also is the performance of the objective; there is little doubt that the prism owes its fair popularity to its ability to give some sort of a contrasty image, even when no attention has been paid to illumination and with almost any objective. Its only legitimate use is for screen demonstration purposes with a low power objective, when its more brilliant illumination is of value. When an opaque reflector is used, or when the aperture of an objective is to be restricted, it becomes necessary to have the objective "short mounted," in order to reduce as far as possible the tendency of the prism or the aperture stop to act as a field stop and cause uneven illumination; but when a transparent slip is used and the objective fully illuminated, there is no necessity for short mounting, and the standard high power immersion objective, in its longer mount well blackened inside, may even be preferable.

The type of objective which will give exquisitely fine central definition and resolution, but whose field is so curved that only one small zone can be brought into sharp focus, is only of occasional use to the photomicrographer. It is well known that maximum central definition and resolution can only be obtained with some sacrifice of flatness of field. In respect of flatness of field the achromats generally score over the apochromats, but no general rule can be laid down.

Metallurgical specimens are for the most part monochromatic in character, and allow of the use of a colour screen best adapted to the corrections of the objective in use. Most achromats will give very good definition with either green or yellow light, and it is very seldom that the need for a colour other than one of these two is experienced. It follows therefore, that an achromatic objective giving sharp definition under moderate eye-piecing or its equivalent is very satisfactory for most work, and if it is superior as regards freedom from flare and flatness of field to an apochromat it may prove much more satisfactory.

A photograph (Plate XIII) is shown taken at X3500. For this an apochromat has been used with advantage owing to its superior central definition and resolution; this particular apochromat, however, is definitely superior to most in flatness of field and absence of flare. This micrograph serves to show that definition and resolution are not impaired by the use of



·7 o/c C. STEEL, AIR COOLED FROM 800° C. × 3500.

a suitable transparent slip illuminator, since they are up to the standards obtainable in biological and other transmitted light work.

The photomicrographic apparatus used by the author is shown in Plate XII, figs. iv and v. It was not designed solely for metallurgical work. A considerable amount of photography of transparent specimens is done on it, and as many of these are mounted in liquids a horizontal stage position of the microscope was essential. The microscope itself stands on a heavy metal block, keyed on its surface to take into register with the camera either of the two microscopes, one a metallurgical and the other a petrological, which are used. The condensing system is mounted on a V bar, which may be raised or lowered by a worm gear mounted underneath the table, and in this way the illuminating beam may be brought into alignment with either a high or low position of the metallurgical microscope's vertical illuminator, or with the substage mirror of the petrological stand. The V bar is long enough to accommodate when necessary an arc lamp with its condenser train, cooling trough, etc. The camera itself is a whole plate, square bellows; no long distance fine focussing control is fitted, when high magnifications are required a high power ocular is used.

The illuminating system shown in use is the 100 c.p. Pointolite (fig. 4).

The lens B is mounted in an ordinary between-lens diaphragm shutter. This shutter is fitted with an antinöus release which is used for making exposures, and the iris diaphragm serves as the field stop.

There are on the market some very elaborate photomicrographic outfits for metallurgy. The aim in the design of most of these has been to combine a horizontal stage position with a horizontal camera. The horizontal camera certainly provides a more comfortable working position, and a horizontal stage is desirable to obviate the risk of sliding of heavy specimens on a vertical one. The optical system of the microscope itself has, however, to be complicated by the introduction of prisms to meet these requirements.

With regard to the mechanical features of the metallurgical microscope, the main requisites are strength, and a full range of stage movements along the axis of the microscope. To change from a $\frac{1}{2}$ in. to a 3 in. objective requires a movement of about 4 in., and in addition there is the considerable variation in the thickness of metal specimens to be allowed for, so that the usual 2 in. of stage racking movement is insufficient. The stage should be strong enough to carry a heavy specimen without straining from the normal, and whilst fitted with springs to hold a small specimen mounted on a glass slip, these should be removable, leaving a large clear stage to carry such a specimen as the cross sections of a rail.

The tube should be short enough to take a vertical illuminator without exceeding the standard 160 mm. of the objectives, and a finish on the stand which is as impervious as possible to acid fumes is desirable.

VI.—THE BEST METHOD OF ILLUMINATION OF METALLURGICAL SPECIMENS WITH THE VERTICAL ILLUMINATOR.

By CONRAD BECK, C.B.E., F.R.M.S.

(*Read at the LIVERPOOL CONFERENCE, March 31, 1927.*)

FIFTEEN TEXT-FIGURES.

WHEN Mr. Harold Wrighton's photomicrographs are examined it is seen upon measuring the intervals between some of the finest bands of black and by dividing these intervals by the magnifying power, that lines about $1/150,000$ of an inch apart are resolved and well separated from each other. Some of the small dot structure appears to be equally fine, but it is not so easy to express its dimensions.

This resolution is obtained with a lens of 1.3 N.A. It is beyond the theoretical limit of visual resolution and is approximately up to the theoretical photographic limit. It is probably the finest regular structure of any kind that has yet been photographed with the microscope.

The method of illumination which he has developed by analogy with the well-known methods of critical transparent illumination seemed to warrant a consideration of this subject from a purely optical point of view.

Before doing so I made a series of experiments visually on structure, which was so near to the limit of the resolving power of the lens in use, that it could be resolved with green or blue light, but was unresolved with red light, and the resolution could only be obtained under the best conditions.

The result of these experiments was entirely to confirm the advantage of Mr. Wrighton's method, and has suggested that the title of this paper may not be too dogmatic.

The resolution of a microscope depends upon the aperture of the microscope object glass and upon whether the aperture is being utilized to the full. If by means of a diaphragm placed behind an object glass its aperture is reduced, the power of seeing the fine detail is reduced in proportion, until when the aperture is exceedingly small, the microscope ceases to show more than can be seen with the naked eye.

When the magnifying power of a microscope is increased, so the aperture must be increased to show the finer detail demanded.

Thus each object glass has an aperture suitable to its magnifying power,

but the whole aperture must be utilized to make the best use of that magnifying power.

If an opaque material which is being examined by a microscope has a rough or matt surface which scatters light in all directions, whatever method of illumination is used, the whole aperture of the object glass will be fully utilized and maximum resolution will be obtained.

In fig. 1, the incident light may fall upon the object from any direction. It will be scattered by the uneven surface in all directions, and as far as resolution is concerned, the full aperture of the object glass will always be filled with light. It is not, however, this class of surface that we are at the moment concerned with.

In order to reveal the structure of a metal, a surface is produced which is

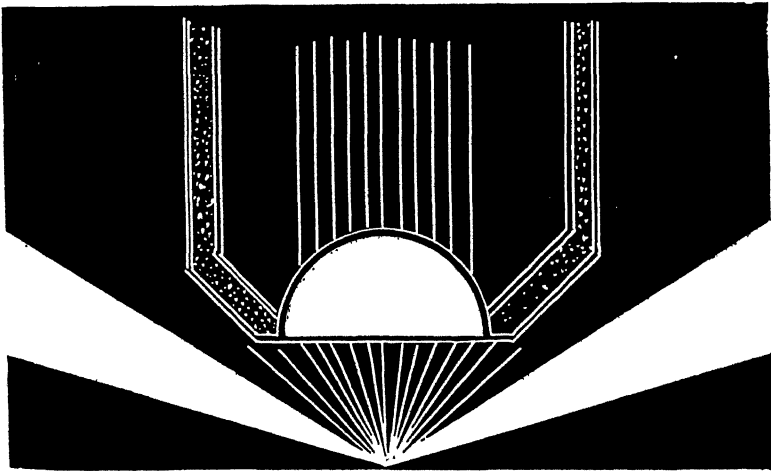


FIG. 1.

polished and etched, and which, disregarding the etched portions, acts as a mirror. It does not scatter light, but reflects it according to the laws of reflection. The usual method of illumination is by means of a reflector placed behind the object glass, which directs a beam of light through the object glass itself upon this mirror surface.

Thus if (as in fig. 2) a fine beam of light is directed by a prism or other reflector through the object glass on to this mirror surface, the incident light is reflected back at the same angle as that at which it arrives, but on the other side of the axis, and the only portion of the aperture of the object glass that is utilized is the portion through which the light A B travels. It is the same as if a transparent object (fig. 3) were illuminated with a substage condenser which had a small pinhole stop placed out of centre below it. It is true that those portions of the specimen which are etched and not polished are scattering the light, which passes through all parts of the object glass,

but the amount reflected from the mirror surface is so much greater in intensity that this scattered light is generally too feeble to have much influence on the image.

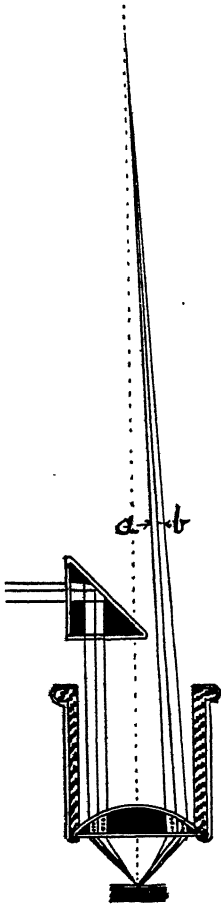


FIG. 2.

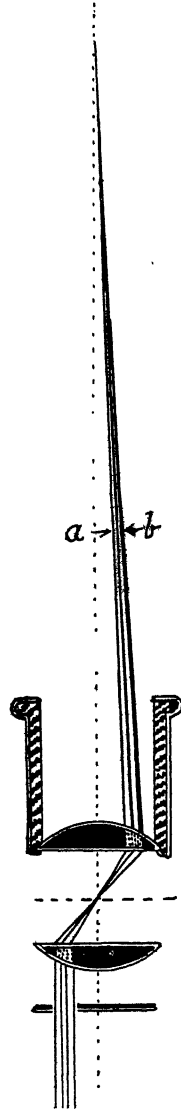


FIG. 3.

It is evident that when examining a mirror surface by this means, if the whole aperture of the object glass is to be filled with light as it returns from the mirror, the whole aperture must be filled with light when directed upon

the mirror. Thus a beam of light at least as large as the back lens of the object glass must be directed through it (fig. 4). It corresponds to a transparent object illuminated by a substage condenser (fig. 5) where the

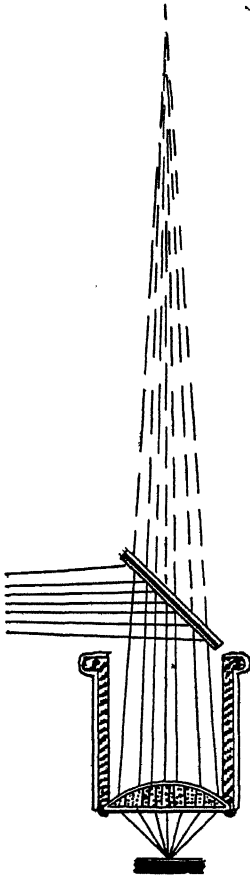


FIG. 4.

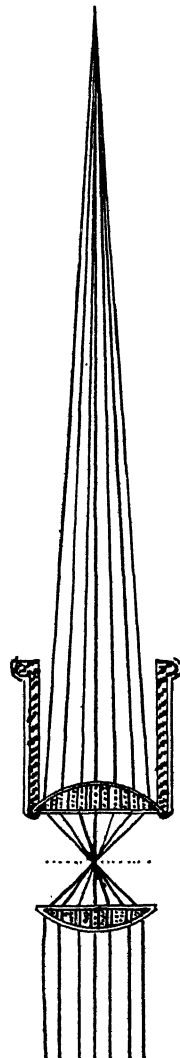


FIG. 5.

aperture of the condenser is capable of filling the full aperture of the object glass.

The consideration of the relative conditions of the two forms of illumination is instructive.

For instance, suppose the illumination is out of centre, in both cases the aperture is not properly utilized (figs. 6 and 7).

Suppose the light is not focussed upon the surface of the object, again in both cases the aperture is not fully used (figs. 8 and 9).

The study of transparent objects with a substage condenser out of centre, out of focus, and with small oblique stops, forms a useful indication of the class of erroneous effects that may be obtained with a vertical illuminator when the illumination is incorrect. With such incorrect illumination the resolution is not at its maximum. In cases where high resolution is not required, this may not be of the greatest importance, but even then with

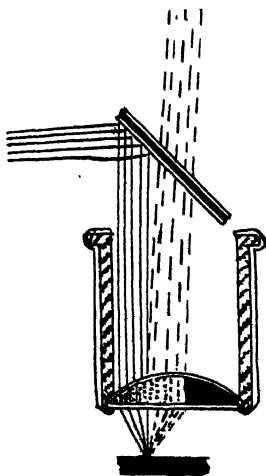


FIG. 6.

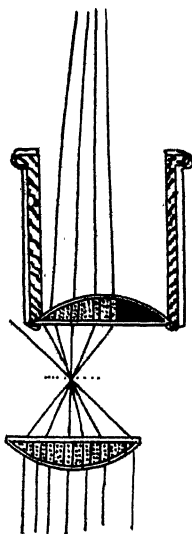


FIG. 7.

the light seriously out of centre or out of focus, or the aperture only filled with a small oblique beam of light, entirely spurious effects and ghost images are often obtained which are quite misleading.

Thus in order to obtain the maximum resolution :—

- (1) The light must be centred.
- (2) It should be in focus.
- (3) It must fill the whole of the back lens of the object glass.

As any form of prism illuminator or opaque reflector such as a silvered mirror reduces the aperture of the object glass, and also cannot fill the whole aperture with incident focussed light, such reflectors cannot be used for obtaining really first class results. It is unfortunate, because they have

advantages in giving more light and in preventing glare from the surfaces of the lenses, but except for use with low powers, they are unsatisfactory, and this discussion must assume that a transparent reflector such as a thin glass of a size at least as large as the back lens of the object glass is employed. This reflector should be very thin to avoid astigmatism and a double image of the source of light.

The illumination of a transparent object is provided for by a separate illuminating system, the substage condenser. This is provided with a focussing adjustment, a centring adjustment, an iris diaphragm and patch stops, and by its means the beam of incident light can be completely regulated, but with vertical illumination where the object glass which forms the image

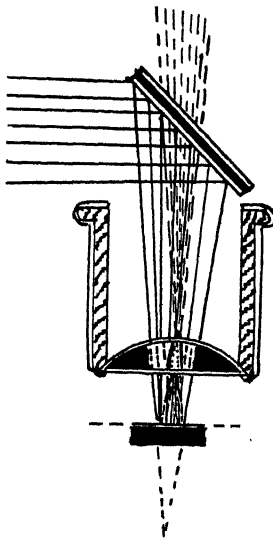


FIG. 8.

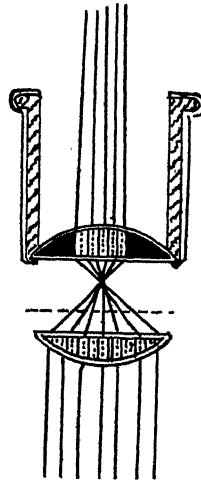


FIG. 9.

of the object also assumes the function of a substage condenser, these adjustments cannot be applied, and everything must be done by the exact arrangement of the illuminating beam of light.

Bearing in mind the three conditions necessary for perfect illumination, the focus of the illuminating beam that will fulfil these can be specified.

1. *The Light must be Centred.*—Whatever form of illumination is used, the beam should be at right angles to the tube of the microscope, and must be pointed directly at the centre of the transparent reflector. If an optical bench is used, two small pinhole diaphragms may be placed in the holders which carry the lenses, and the lamp adjusted till it throws the light through the two pinholes upon the centre of the reflector, or one of the lenses may be slid along the bench till an image of the light is formed on the reflector,

and the lamp adjusted till this image is in the centre. This position may also be ascertained by holding a piece of paper or ground glass against the aperture in the vertical illumination mount, through which the light enters.

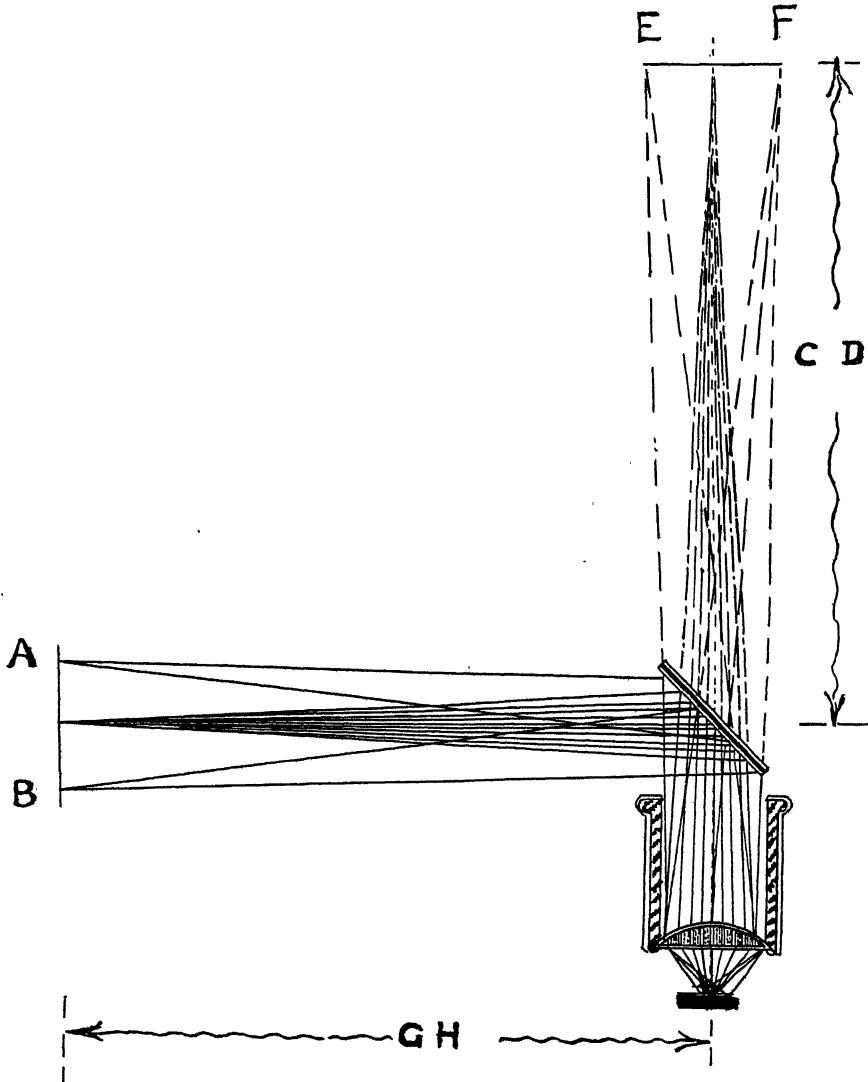


FIG. 10.

2. *The Light must be in Focus upon the Object.*—This means that the light, or an image of it, must be at a particular distance from the microscope. The microscope is forming an image of the object in the eyepiece (fig. 10, E F) at a distance, dependent on the tube length, of say 160 mm. from the reflector.

The distance CD must be equal to the distance EF . The incident beam of light then follows exactly the same course as the emergent rays except that it is deflected at right angles by the reflector.

Now the size of the field of view is the size of the image EF in the eyepiece, and, therefore, if the whole field is to be illuminated, the size of the lamp at AB must be as large as EF . This, with a low-power eyepiece, is about $\frac{3}{4}$ inch.

Few lamps have an illuminated surface of this size, so that some means must be taken to increase its area. One method is to place a ground or

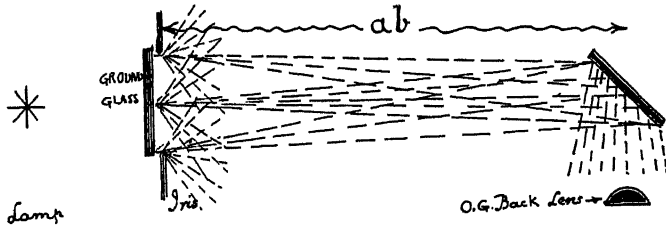


FIG. 11.

opal glass at the correct position, and to illuminate it by any sort of a lamp behind it (fig. 11). There should be a diaphragm close to this ground or opal glass, and it should be set to such a size that no more of the specimen is illuminated than the field of view being examined, and as the field of view varies with different eyepieces, it is best to use an iris diaphragm

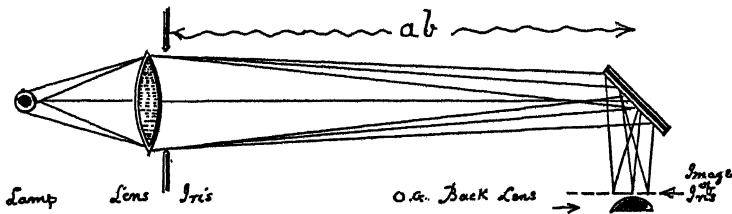


FIG. 12.

which can be closed till it just does not appear in the field of view of the image.

This reduction of the area of the source of light has been found in practice to give clearer and more brilliant pictures, though why it should do so is not obvious. It is probably due to scattered light from the portion of the specimen not included in the field of view. This method of employing an illuminated ground glass behind an iris diaphragm has serious disadvantages. The ground or opal glass absorbs a large percentage of light, also a large amount of extraneous light is thrown into the microscope which is not used in forming the image. It, however, fulfils the condition No. 3 that *the light must fill the whole aperture of the object glass*, but experience

shows that the light should not more than fill this aperture, or there will be a great deal of glare caused by reflection from the sides of the mount on to the lenses of the object glass and back into the eye. Therefore, it is better to replace the ground glass by a lens (fig. 12) of suitable focus, which will produce an image of the source of light at a position close to the back lens of the object glass, and to arrange the focus of the lens so that this image of the light source is of a size scarcely larger than the back lens. The whole aperture of the object glass is used, and no light except that actually used for illuminating the object enters the microscope.

A slight variation of the distance of the lamp from the lens AB and the lens from the diaphragm BC is permissible, which enables the image of the lamp on the surface of the back lens of the object glass to be varied to suit small differences in the diameter of different object glasses, but such a method does not allow of the use of large sources of illumination and is only suitable to such illuminants as a Pointolite or a small arc lamp, and

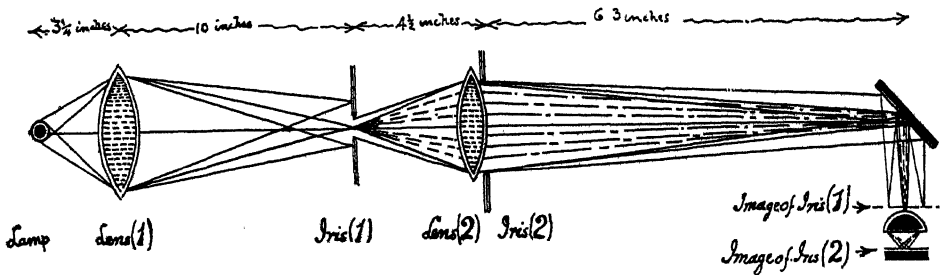


FIG. 13.

it has the disadvantage that it will not correctly fill the lens of object glasses with light that have very large back lenses.

The following system (fig. 13) arranged on an optical bench fulfils every condition by enabling the size and shape of the source of light to be controlled.

Lens (1) produces an image of the lamp at the position of iris diaphragm (1). This image becomes the source of light instead of the lamp itself. The distance of the lamp and lens (1) is so arranged that the image is rather larger than will ever be required, and by means of the iris diaphragm (1) this secondary source of light can be varied in size.

Lens (2) focusses the iris diaphragm (1) to a position close to the back lens of the object glass, it having been reflected down by the transparent mirror. It is placed with its iris diaphragm (2) at the same distance from the reflector as the reflector is from the eyepiece image in order to focus iris diaphragm (2) upon the objects. By this arrangement the iris diaphragm (1) allows the beam of light to be varied so as to exactly fill the back lens of the object glass, and the iris diaphragm (2) allows the area of field illuminated to be exactly controlled.

If the lamp is an arc lamp or Pointolite with a small incandescent area,

lens (1) should give an enlarged image on iris diaphragm (1) magnified, say, three or four times. If it is a source of illumination with a large area, it can be reduced in size. The most convenient method of setting up the apparatus is as follows, first move the lens (2) and its iris diaphragm (2) until the latter is in focus upon the specimen when looking through the microscope, and then remove the eyepiece of the microscope, and by observing the mount of the back lens of the object glass, move the iris diaphragm (1) to and fro on the optical bench until it is in focus upon this mount.

If the image of this diaphragm cannot be seen, a card may be held on the side of the microscope opposite to the light at a distance about equal to that from the reflector to the back lens and the iris diaphragm (1) focussed

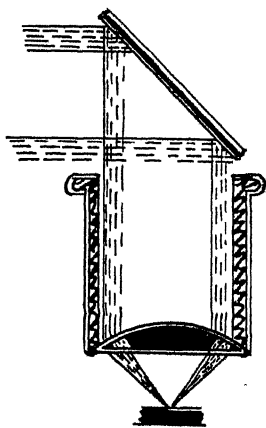


FIG. 14.

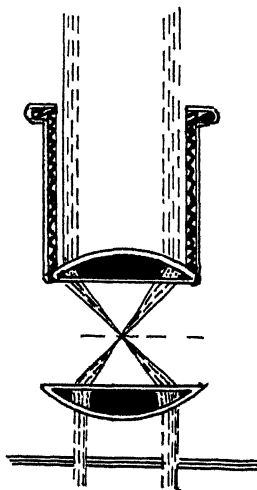


FIG. 15.

upon it. The lamp and lens (1) may then be slid to and fro on the bench till a suitable sized image of the lamp is focussed upon the iris diaphragm (1). The sizes of the iris diaphragms may now be opened or closed to obtain the conditions previously specified.

In fig. 13 one set of positions are given that will produce the desired arrangement, but these dimensions can be varied to suit lenses of different foci. Lenses (1) and (2) may be corrected lenses if desired, but there is little advantage to be obtained over simple uncorrected lenses.

Another form of illumination has been strongly recommended by Professor Carl Benedicks, and this arrangement of the illuminating beam of light permits his method to be adopted. It is an illumination that corresponds with the use of patch stops in a substage condenser.

It is obvious that when the object glass becomes the light condenser, patch stops cannot be introduced easily or advantageously behind the back lens of the object glass, but with the illumination as described in fig. 13 patch stops can be placed close to the iris diaphragm (1), and as the image of this diaphragm is projected upon the back lens of the object glass, optically the same result is obtained (fig. 14). The only light that reaches the opaque specimen is a ring of light which passes down the margin of the object glass and falls obliquely upon the object. Fig. 15 shows a corresponding illumination produced on transparent objects by a patch stop placed below a substage condenser. This method has been condemned for transmitted illumination as producing spurious and unreliable results, but the conditions in examining opaque surfaces are not the same, and the effect of this oblique illumination on a metal etched surface is to cast shadows which give the effect of relief.

By varying the shape of the aperture at the position (1) fig. 13, the nature of the illuminating beam of light can be modified. The simplest form is to have a circular opaque disc (fig. 16, 1) (say an opaque spot on a transparent glass plate) which is placed exactly in the centre of the aperture formed by the iris diaphragm. This produces an annular ring of light

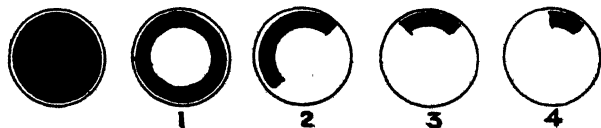


FIG. 16.

which falls obliquely upon the surface of the object in all directions, but Professor Benedicks places close to the central disc (which he calls an epiphram in distinction to a diaphragm) a sector shutter by which portions of the annular bundle of light may be cut off so that the illumination may be by a portion of an annular ring varying between 60° and 360° of the whole circle (fig. 16, 2, 3, 4). By this means shadow relief effects can be obtained by illuminating the objects from different directions.

Great care must be employed with this form of illumination to centre the epiphram so that its image truly occupies the central portion of the object glass and a centring adjustment must be provided to the holder containing this apparatus.

Professor Benedicks claims that this form of illumination reveals structure otherwise invisible. It probably reduces resolution somewhat, although it may be not to any great extent, as it probably increases the scattered light as compared with that directly reflected, and if there is sufficient scattered light, the full aperture of the object glass may be partially made use of. In any case, resolution is not destroyed in the same manner by stopping out the centre of an object glass as by cutting off its margin.

It is probably at present unsafe to express an opinion as to whether such a method is an important advance, for although Professor Benedicks shows striking results, they do not appear to include structure so near the limit of resolution as those which Mr. Harold Wrighton has photographed with a full aperture cone.

The essential principle appears to be an increase in visibility due to shadows. Increase in visibility due to shadows is well observed on a snow field, where with an overcast sky giving illumination in all directions the whole expanse appears as a level plain, whereas when the sun is shining, light coming from one direction only produces shadows more or less pronounced, by which every slight irregularity is clearly discerned. With a mirror surface, similar results might be expected if the surface is not absolutely flat.

The glare produced by reflections from the surfaces of the lenses of the object glass can probably never be entirely got rid of with this form of illumination. It is generally more pronounced with low power object glasses than those of higher power. It depends chiefly on the curvature of the surface nearest the reflector. The deeper the curve the less the glare, because the reflected light is dispersed by a deeper curve over a larger area, and the proportion that reaches the observer's eye is only a small fraction of the reflected light.

The prevalent idea that lenses mounted in short mounts are better for metallurgical work has no justification when a transparent reflector is used, and it is doubtful if they have an advantage with opaque reflectors, but as these are not to be recommended except with low powers, and as low powers cannot be mounted in much shorter mounts than those normally supplied, the practice of mounting metallurgical lenses in short mounts might probably be discontinued with advantage.

An iris diaphragm between the body of the microscope and the vertical illuminator is a most useful addition to a metallurgical microscope, as by its means all scattered light from the mount of the vertical illuminator can be cut off.

Various forms of lenses and diaphragms on an optical bench have been supplied, but, in my opinion, they should all be made to conform to the method here described, though the exact focal lengths and separations of the two lenses and the two diaphragms may be modified to suit the convenience of the operator.

VII.—SOME OBSERVATIONS ON THE MICROSCOPICAL STUDY OF DETERIORATED FABRIC FROM EARLY EGYPTIAN TOMBS.

By A. C. THAYSEN, Ph.D., and H. J. BUNKER, M.A.

(Read at the LIVERPOOL CONFERENCE, March 31, 1927.)

ONE PLATE.

THROUGH the courtesy of Mr. A. Lucas, O.B.E., F.I.C., Chemist to the Egyptian Department of Antiquities and late Director of the Chemical Laboratories of the Egyptian Government, the authors have been able to examine some specimens of fabric from two early Egyptian tombs. The primary object in view in these investigations was to attempt to throw light on the controversial question of the causes and processes of the deterioration of these ancient fabrics.

The available material was taken from the two most recently discovered Egyptian tombs, that of Tut-ankh-amen, of the Eighteenth Dynasty, dating from about B.C. 1350, and situated at Luxor, and the tomb of Queen Hetepheres at Giza. Hetepheres was the mother of Cheops, and the wife of Sneferuw, first king of the Fourth Dynasty, and the tomb therefore dates from about B.C. 3000. A description of this tomb appeared in *The Times* of March 2nd to 5th last.

The Tut-ankh-amen material, which is linen, is woven into two or three different types of cloth. Microscopically the condition of the material appears to vary very considerably. Some parts are light buff in colour and comparatively strong, while elsewhere the fabric is dark brown and extremely brittle, and in the worst condition is reduced to an almost black dust, which the microscope reveals as a mass of small fragments of fibre. A much larger piece of fabric taken from the store chamber of the tomb this season shows further interesting features. Spread irregularly throughout the material are large dark areas, which are very weak and, in most cases, have their centres entirely decayed and missing. Besides these larger holed areas, to which reference will be made later, there are, throughout the whole of the fabric, a large number of small holes which are entirely independent of any discoloration of the fabric, occurring indiscriminately in both the decayed and in the better preserved material. The cause of these small holes, which have the appearance of having been "eaten out" of the fabric, is unknown. But for the fact that insects do not usually attack cellulosic fabrics, one would be inclined to attribute these holes to the action of a small beetle which feeds on and destroys dead organic matter, *Gibbium psyllioides*,

Czemp, the chitinous skeletons of which are found associated with the fabric and throughout the boxes in the tomb.

The investigators who have been concerned with the examination of the tomb, and of articles taken from it, consider the deterioration of the fabric to be entirely or in large part due to fungi, or less generally, to bacteria.

For example, with regard to the large decayed spots on the fabric just referred to, Lucas is emphatic in attributing them to fungi. He states that he is finding evidence of fungoid action throughout the tomb. "A number of small gilt wooden statuettes have been found," he says,* "each one loosely covered with a piece of linen. Each of the statuettes was contained in its own box. Both the boxes and the portions of the statuettes not protected (i.e. head, feet and pedestal) were almost covered with the dry remains of typical fungus spots, and there were patches of similar spots on some of the linen coverings." (On the one sent will be found) "dark and light-coloured brown patches: these are typical of most of the decayed linen. There is no doubt whatever of patches of fungus on some of these linen coverings, they are spotted like most of the objects in the room (now) being dealt with, which is worse, and has evidently been damper than the two preceding rooms."

That conditions must have been suitable for the growth of micro-organisms when the tomb was sealed is certain. The humidity must have been high from the wet plaster on the walls of the tomb and from the perspiration of the workmen erecting the shrines and carrying the objects into the tomb.

Lucas also points out [Carter, 1927] that the tomb is at the lowest level of the valley and near the surface of the rock, which may possibly have been damp from the heavy rains that occur about once in every decade. Carter, Lucas, and Scott [Carter, 1927] all refer to brown fungus growths occurring all over the walls of the Burial Chamber, where they are stated to be so plentiful as to cause great disfigurement. They also occur to a lesser extent on the walls of the ante-chamber.

While attributing these spots to fungi or bacteria, Lucas and Scott record that nothing resembling mycelium or sporangia has been discovered by their microscopical examination of these spots.

None of the fabric examined by us was from the actual mummy of the king, but the remarks on the deteriorated mummy wrappings by Dr. Derry, Professor of Anatomy, Egyptian University, and by Mr. Lucas [Carter, 1927], are of particular interest, since they indicate the view of these authorities on the causes responsible for the decay of fabrics in the tomb. Dr. Derry says that the extreme fragility of the bandages "seems to be due to the inclusion of some humidity at the time of interment, as well as the decomposition of the unguents, which generated a high temperature and thus brought about a sort of spontaneous combustion which carbonised the

* Private communication from Mr. A. Lucas.

wrappings." Similarly, Mr. Lucas favours the idea of a slow spontaneous combustion, in which he considers that fungoid growth played a part. He assumes that after a time the fungal activity was succeeded by chemical changes.

The existence of fungus growth in the tombs of Tut-ankh-amen is supported by the observations of Dr. Scott and Miss Wakefield [Carter, 1927], who found a single tuft "which looked like a tiny patch of cotton wool on the outside of the sarcophagus, beginning just above and continuing over the incised line of hieroglyphics around the upper part." The apparent fungal hyphæ spread over the red coloured figures, but avoided those coloured yellow. The fact that the yellow colour was arsenic sulphide, and therefore poisonous, afforded additional evidence that the tuft was due to fungal hyphæ, which may have subsequently died. This was confirmed microscopically, though any identification of the fungus was impossible owing to the absence of fructifications.

As regards the tomb of Queen Hetepheres, Mr. Lucas, in a private communication, states that he found evidence of fungal action everywhere. And he adds that, though the tomb is well above any subsoil water level, and is now quite dry, the air must have been humid from wet plaster, and the perspiration of the workmen when it was first sealed. Dr. Reisner [1927], describing the discovery of the tomb in a series of articles to *The Times* says, that the greater part of the wood was shrivelled or reduced by fungus to grey powder. The cloth, the matting, the basket work, and all organic material were in a similar condition. He suggests that with the lapse of time the boxes of wood in which so much of the material was stored, and the wooden parts of all the furniture, decayed or were destroyed by fungus.

How far, it may be asked, can these statements on the presence and the activity of micro-organisms be confirmed by an investigation of the decayed plant structures, notably the fabrics found in the tombs.

A direct microscopical examination of the fabrics throws very little further light on the question. In the case of the material from the tomb of Tut-ankh-amen for instance, there may be seen under the microscope portions of the fabric in which the linen fibres are still intact and retain their ordinary conformation in bundles, while other parts may show practically every stage between this and a complete disintegration of the fibres. The presence of a mycelium or of individual bacteria is not to be detected by direct microscopical examination, even in the case of the seriously damaged parts of the fabrics.

EXPLANATION OF PLATE XIV.

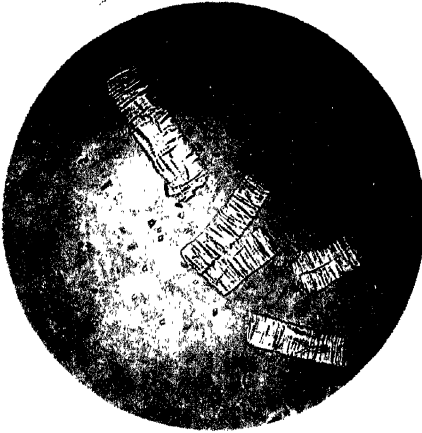
Fig. 1.—Linen fibres from Tut-ankh-amen fabric, mounted in 15 p.c. NaOH. $\times 400$.

Fig. 2.—Spore-like body from Tut-ankh-amen fabric. $\times 800$.

Fig. 3.—Fragment of fungus mycelium from Tut-ankh-amen fabric (above, a portion of linen fibre). $\times 400$.

Fig. 4.—Sporangium-like body from Tut-ankh-amen fabric. $\times 400$.

Fig. 5.—Group of spore-like bodies from Hetepheres material. $\times 200$.



1



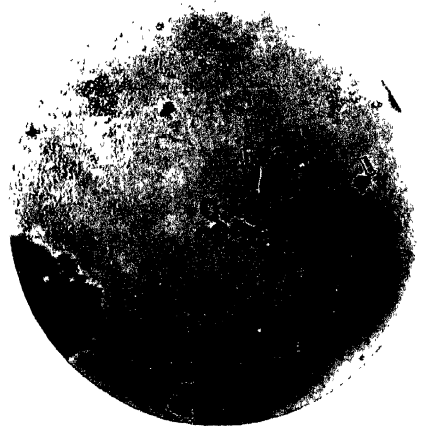
2



3



4



5

This, of course, might be due to the mycelium having been disintegrated in the course of time, and would not necessarily prove that a microbiological decay had been non-existent. There are methods available, however, by which fairly conclusive evidence can be obtained as to the participation of micro-organisms in the destruction of fabrics, methods which are based on the microscopic appearance of fibres after treatment with concentrated solutions of sodium hydroxide, either alone or in mixture with carbon bisulphide.

One of these methods in which a mixture of carbon bisulphide and sodium hydroxide is used was described by us in a paper read before the Microscopical Society [1923]. It was found unsatisfactory to adopt this method for the examination of the decayed fabrics, since a complete resolution of the fibres occurred before their exhaustive microscopical investigation could be completed. Recourse was therefore had to the less drastic treatment of the fabrics with a 15 p.c. solution of sodium hydroxide—without any addition of carbon bisulphide. The appearance of the damaged fibres treated in this way is shown in fig. 1.

It will be seen that the deterioration has lead to a weakening of the fibres through the appearance of numerous regular fissures running chiefly vertical to the longitudinal axes of the fibre.

An appearance such as this would not be expected if micro-organisms had taken a primary part in the destruction of the fibres. It represents what would be observed in linen fibres which had been damaged by acids, heat or ageing.

The outstanding feature of flax fibres which have been damaged by an agency other than micro-organisms is, according to Searle [1924], the segmentation of the fibres into regular and sharply defined components. The transverse segmentation is the more marked, but is accompanied in heavily tendered fibres by longitudinal segmentation also. A comparison of the figures shown demonstrates clearly the marked difference in appearance between micro-biologically tendered fibres and those damaged by other agencies, the irregularly torn and serrated appearance of the former contrasting strongly with the clear cut segmentation of the latter. In the case of slighter tendering the differentiation might not be so marked, but nevertheless, would be sufficiently clear to be distinguished by the experienced eye.

The material available from the tomb of Queen Hetepheres was, unfortunately, too completely disintegrated to throw further light on the cause of the decay of fabrics in ancient Egyptian tombs. It does, however, possess several other features of interest which should not be overlooked.

The material received from Mr. Lucas consisted of a large piece of material and a small sample of decayed wood. The former sample to the naked eye appeared to be a large lump of porous mineral matter, easily crumbled and resembling a piece of soft pumice. The decayed wood was covered with a silver white layer which in places was scaly, in others almost woolly and suggesting the appearance of a fungus mycelium.

But for the fact that the former sample was asserted by Mr. Lucas to be

composed of decayed woven fabric, nobody would have anticipated that it could contain anything of an organic nature. Examined chemically it was found to contain 79.1 p.c. of inorganic matter consisting of about 50 p.c. of calcium carbonate. It was originally enclosed in a wooden box which, however, had decayed completely. Lucas stated in his communication that it was a long time before he could bring himself to believe that the material was cloth, although in a few places there were traces of the cross thread. He has no hesitation now in declaring it to be, or rather to have been, a woven fabric, and he mentions that he possesses samples of it in various stages of decay. The material is impregnated with extraneous sand and limestone dust, and when examined directly under the microscope there are seen in it what appear to be fragments of mineral matter. However, after treatment with dilute hydrochloric acid the crumbly material reveals short lengths of fibre as seen in fig. 3. The definition of these fibre particles is insufficient for the cause of deterioration to be diagnosed.

A microscopic examination of the silvery covering of the sample of wood from the same tomb, established beyond doubt that it could not be a layer of fungus mycelium. It was found to be a plaster mould or impression of the wood on which it lay. The more woolly portion of the surface covering of the wood which, to the naked eye, resembled a fungus mycelium, were found on microscopical examination to consist solely of needles of an inorganic nature, probably of calcium sulphate, interspersed between the wood cells.

In addition to the structures referred to, there was found in the wood sample a considerable amount of fragmentary but typical cellular material, soluble in concentrated sulphuric acid.

From what has been said, it will have been gathered that the investigation of the available material from the two tombs had tended so far to disprove rather than to support the view that micro-organisms, notably fungi, had been responsible for the destruction of the materials examined. Searle [1924], who examined a number of samples of linen cloth from Egyptian tombs of different dynasties by the method recommended by Fleming and Thaysen [1921], came to the conclusion that in no case was the tendering due to micro-organisms but to "ageing."

The reactions covered by the term "ageing" cannot be defined, though recent investigations by the authors in collaboration with Mr. W. E. Bakes [1926] have shown that they result in the formation of the same humification products as those which may be obtained by the action of concentrated sulphuric acid on carbohydrates.

However, the emphatic statements of the authorities in charge of the excavations of the two tombs in Egypt, statements to which reference has already been made, could not compel one to hesitate before accepting the uncompromising view expressed by Searle as to the cause of the decay of fabrics in Egyptian tombs. This natural hesitation made the authors decide to attempt once more to find direct evidence of the presence of micro-organisms, notably of fungi in the available samples of fabrics. For this

purpose a piece of the badly decayed material from the fabric of the tomb of Tut-ankh-amen, was mounted in 15 p.c. sodium hydroxide solution on a microscopic slide and exposed to the action of the alkali until the cellulose contained in it had been brought into colloidal solution. In this way a microscopic study of the remaining structures from the material became considerably facilitated. It was observed with the aid of the microscope that some of the slides prepared as above contained structures which might be remains of a fungus mycelium. In one case a body which was undoubtedly either a spore of a fungus or the cell of a torula species was seen. The most characteristic structures observed are illustrated in figs. 2, 3 and 4.

After mounting some material from the fabric of the Giza tomb in dilute hydrochloric acid for the removal of soluble inorganic admixtures, it was possible in this material also to detect in one of the preparations four bodies which were undoubtedly spores of a fungus (fig. 5). These spores were of considerable size, measuring from $15\ \mu$ to $16.5\ \mu$ by $20\ \mu$.

The existence of fungi in the fabrics investigated had thus been made highly probable. Nevertheless, it would be incautious to attribute to this agency more than a purely temporary and superficial action on the fabrics on which they were found. The appearance of the fibres of these fabrics under the microscope after swelling was too definitely the appearance of fibres decomposed by non-microbiological means to justify allocating to fungi or other micro-organisms, which might have been present, more than a purely temporary action. But granting to micro-organisms no more than this, they may well have left their marks on the decayed fabrics, and it is quite conceivable that they can have been responsible for the curious appearance already referred to in the material. It has already been mentioned that there were patches in the material in which the deterioration of the fabric had progressed much further than in other parts, and it was in material from these patches where remains of fungi were found. It is quite possible that these patches represent places where fungi spores germinated soon after the closing of the tomb, and developed for a time sufficient to affect the chemical structure of the fibres to such an extent that, without visual damage, their subsequent deterioration through ageing progressed at a greater rate than in the remaining parts of the fabric.

Why their development should have ceased prematurely it is impossible to say, unless it be that a comparatively rapid drying out of the tomb and of the material in the tomb occurred, which brought the moisture content of the fabric below the minimum required for the growth of fungi. Support for this view may perhaps be found in the discovery in the sarcophagus of a dagger, the iron blade of which showed only occasional strains of rust.

Seeing that microbiological activity is likely to have occurred in the tombs, it was natural to ask whether the organism responsible for this activity could be still alive.

Through the kind offices and with the collaboration of Mr. Lucas, the authors were able finally to settle this question of the possibility of life in its

most resistant form, being capable of surviving the centuries which lay between the closing of the tomb of Tut-ankh-amen and its rediscovery and opening a few years ago.

Immediately after the opening of the sepulchral chamber, and before access was allowed to its north-western corner, Mr. Lucas was able to remove samples of dust from the floor under aseptic conditions. When examined by the authors for the presence of micro-organisms—an examination it need hardly be added which was undertaken with the awe which this exceptional material inspired—no living micro-organisms could be found in any of the six samples available.

CONCLUSIONS.

Fabric from the Tomb of Tut-ankh-amen.

1. There is evidence pointing to the possibility that destruction by micro-organisms occurred in the tomb immediately after its closing, but so far as the fabric is concerned, this action must have ceased after a localised and superficial attack on the material.

2. The fabric has since become decomposed by "ageing."

3. No living micro-organisms were found in the tomb.

Material from the Tomb of Heterpheres.

1. The fabric is reduced to an unrecognisable conglomeration of fibre fragments.

2. A group of bodies believed to be fungus spores was found in the lump of fabric.

3. There is no certain evidence of fungus mycelium, the macroscopic simulation of mycelium being due to calcium sulphate used as a plaster on the wood.

4. The woody fibres are in various stages of preservation.

5. Cellular tissue, consisting of cellulose, is still present.

The authors wish to express their thanks to the Admiralty for permission to publish the results obtained. They are also greatly indebted to Mr. A. Lucas, O.B.E., F.I.C., for having procured the material for the investigations and for his co-operation.

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VIII.—THE ECOLOGY OF THE FRESH-WATER POLYZOA IN EAST ANGLIA.

By H. E. HURRELL, F.R.M.S.

(*Read at the LIVERPOOL CONFERENCE, March 30, 1927.*)

SKETCH MAP.

THE engrossing interest now taken by microscopists in the Fresh-water Polyzoa, formerly named Bryozoa or Moss animals, calls for some clearer and more definite information as to the ecology of these beautiful animals. All who have studied the order Phylactolæmata to any extent will have become acquainted with Allman's superb monograph on the subject, and Hincks' more recent work on the marine polyzoa, as well as the very illuminating work of Dr. Kraepelin and other German workers. So far as the British families are concerned they are fairly plentiful in most parts of the British Isles, and are met with in almost every piece of still water, such as our rivers, lakes, ornamental water, and the like. I doubt if they are to be found at all in any of our swift-running streams, as their frail dwellings are, in some cases, rather simple in construction and liable to become encrusted with sand and debris of all kinds, and, if they existed at all, would only do so in small detached colonies and not in the prodigal fashion in which Nature has scattered them in more favourable habitats. Polyzoa, like many other forms of "pond-life," may exist in many parts of the country where they have not yet been observed, for the simple reason that no one has taken the trouble to make the search, but with the numerous naturalist societies existing up and down the country it is difficult to believe that there can be any district at this late date unexplored. During the past twenty years and more it has been my special endeavour to see how far the fresh-water polyzoa exist in East Anglia, and more especially in the county of Norfolk and the northern part of the contiguous county of Suffolk. Both these counties are studded with miniature lakes called Broad, especially in the eastern and mid divisions of Norfolk. The map (page 140) shows the most important of these Broad and their situation in respect to the North Sea, which washes the eastern shores of both counties and which has an undoubted influence upon some of the species. It is generally accepted that the fresh-water polyzoa owe their origin to the marine species, or at least they were originally marine forms. It can hardly be otherwise, seeing that some of the habitats where they are to be found in the greatest abundance are in those sheets of water, the beds of which were at one time covered by the sea, as witness the Bramerton Crag, near Norwich, on the River Yare, which is almost entirely composed of sea shells.

The main rivers in the two counties named are the Yare, the Bure and the Waveney, the Yare being about 50 miles long and the Bure probably of greater length, both flow out of Yarmouth Harbour to the sea, but in their upper reaches feed or flow into the Broadlands referred to. The River Yare has only one or two small Broadlands, but these happen to be the richest and most prolific in polyzoa, as will be explained later. The principal Broad on the river is that of Rockland (66 acres), and the two small sheets of water a mile or two nearer Norwich (Surlingham), the acreage of which is probably not more than 20 or 30 at the most, but within the space of from 2 or 3 miles almost everyone of the British species of fresh-water polyzoa is to be found. The Broadlands fed by the River Bure lie well out of the reach of the salt tides that sometimes penetrate to a point of about 15 miles up river from Yarmouth, and here is the true Broadland district, some seven or eight principal Broadlands having a united water expanse of about 1,500 acres. In north-eastern Norfolk, and fed by tributaries of the Bure, viz., the Rivers Ant and the Thurne, is another series of Broadlands, whilst within some 6 or 8 miles of Great Yarmouth are the Ormesby, Rollesby and Filby Broadlands, which are true lakes, and have no connection with any of the rivers mentioned.

The Broadlands in Suffolk are neither so numerous nor in any case so extensive as those in Norfolk, but there are isolated patches where polyzoa abound, and in the vicinity of Ipswich they are also to be found. My chief concern now is to establish the ecology of the Order as far as it has come under my purview in East Anglia. I have always held almost to the point of contention that the principal agent making for the welfare of the polyzoa in the Broad Districts is the influence of the estuary of the River Yare, known locally as Breydon Water, upon the food supply. This is a tract of mud flats 3 or 4 miles in length and $\frac{3}{4}$ mile wide, which is covered at high tide to the extent of 2 or 3 feet. These mud flats provide food not only for the birds congregating there at low tides, but act as a gigantic culture medium for numerous diatoms which, with other algæ, are swept into the river channels and are carried up to the Broadlands at each and every tide. That this is the case I have tested in many ways, and in some sections made of *Cristatella mucedo* one has found many of the species of diatoms common to the estuarial waters, whilst in the conecium of *Fredericella sultana* diatoms of all kinds are to be seen embedded in the horn-like tubes formed by the animal, pointing to the fact that the tiny creature after extracting the sarcode from the frustules of the diatom makes use of the silicious skeleton to strengthen its own dwelling. *Navicula*, *Surirella*, *Diatoma vulgare*, and numerous other species, are so freely used for the tube building process that a prepared specimen almost furnishes the idea of a spread slide of diatoms. With the exception of *Victorella pavida* all the known British species have been found in the Broadlands named. In one cutting or short canal leading from the River Yare to one of the smallest of the Broadlands, one has found the following families represented, viz. *Lophopus crystallinus* in great profusion on the stems of potomageton, yellow water lily, anacharis, the stems of reeds and

rushes, and even on snail shells and submerged branches of trees. During one season I found the roots of the water iris densely tenanted by *Lophopus*, but, strange to say, that although prevalent to a very large extent in these waters, the common star wort never harbours this or any other of the polyzoa. *Fredericella* has a great predilection for the lower parts of the reeds and the free roots of the alder and willow, or on the decayed and sunken branches of trees. *Plumatella repens*, and the many varieties of that vigorous family, will cover the under side of lily leaves, however large they may be, and completely envelope their stalks almost down to their roots. *Cristatella mucedo* has a special liking for the water lily, and one has found the delightfully pellucid colonies of this polyzoon surrounding and completely enveloping the long stalks of the water lily from the river-bed up to the broad floating leaf, which also they will sometimes completely cover. The delicate *Paludicella* seems to require some protection, and is more frequently than not found intermingled with the more robust but yet somewhat diminutive form of *Fredericella sultana*. The strangest polyzoon of all, and the most prolific in growth of them all, is undoubtedly the fungoid form of *plumatella*, formerly known as *Alcyonella fungosa* but now recognized as a true *Plumatellidan*, and named *Plumatella fungosa*. This is to be found at its best in South Walsham Broad, connected with the River Bure some 14 or 15 miles from Great Yarmouth. I have found it spread along submerged branches to the extent of 4 or 5 feet, and even more, whilst some fine spindle-shaped colonies have measured 7 or 8 inches in circumference. At one time it was alleged that this size was attained by successive annual growths, as when these larger sections are cut through there are apparent rings of growth to be seen, but this is easily explained, as the polyzoon is in somewhat the same position as the fixed rotiferon *Melicerta ringens*, which has to build its cell of whatever coloured materials are available at the moment. I am perfectly satisfied after many years' observations that the colonies are deciduous, the whole mass sloughing off the root or branch upon which they have built at the close of each season, viz. September or October, the decaying coenecia liberating the statoblasts to perpetuate the species. This is frequently the only way in which the presence of this polyzoon can be found in what would seem unlikely waters. For instance, whilst out with the Quekett Society on a ramble in North London some years ago, I tried a large road-side pond for rotiferæ and brought up in a tube scores of statoblasts, and immediately searched amongst the decayed branches and wood and found masses of the polyzoon present.

Nearly all the families of polyzoa produce statoblasts, which are a kind of winter bud, and it is by these, and only by these, that some of the numerous *plumatellidans* can be determined.

The only British fresh-water polyzoon that does not produce statoblasts is *Paludicella*, but in their place there is a sort of terminal buds called the *hibernacula*, which may be found cemented down upon the stone or stem upon which the animal had grown, and start a new colony from this point.

In addition to these winter buds, some polyzoa produce larval-like embryos. This is abundantly proved in the case of *Plumatella fungosa*, a spindle-shaped form issuing from the coenecia of the assembled polypides. At the proper season (July to August) these will issue from living colonies in captivity, and if the mass be disintegrated under-water, these young forms will be thrown out in large numbers, and, if properly fed, will proceed some way towards starting new colonies, but not to the extent of forming the well-known fungus-like mass. One of the most interesting things to watch in connection with statoblasts is the opening, say, of *Cristatella statoblasts*, or any one of the *Plumatellas* which are formed much in the same way as a watch case opening in a hinge-like piece, and thus extruding the young polypide.

For some years I have watched the bursting forth of the young polypide from the living statoblasts of *Cristatella*.

There are one or two families of fresh-water polyzoa well established in America, India, Japan and other countries, and I have statoblasts of some of these for exhibition, but I have not yet heard of them or seen them in this country with the exception of the dainty little *Victorella pavidula*. I do not say or wish to suggest that the Norfolk Broads provide the largest number of species of fresh-water polyzoa or in any greater abundance than the lakes and streams of other parts of the country, and if diligent search were made other habitats could surely be found, but it is somewhat strange that with such ideal surroundings as the Norfolk Broads provide, nothing has yet been seen of several species to be named directly. *Victorella* may be found elsewhere than in the Victoria Docks, London. This form was first noticed by Saville Kent upon the hydroid zoophyte *Cordylophora*, which was presumably brought into dock on the bottom of ships from foreign parts. The late Mr. Rousselet once sent me a living specimen, but I have never once seen it or found it, although *Cordylophora* is to be found in luxurious masses in the largest of our Norfolk Broads and in Horsey Mere near the sea. I have searched the hydroid scores of times but in vain. The genus *Pectinatella* found in such masses in American waters has not yet been found in Great Britain. I have received statoblasts of this species from the late Dr. Anandale of Calcutta University, but failed to get them hatched out.

Another strange form not yet found in this country is *Potsiella*, a peculiar little creature having most of the characteristics of the better known polyzoa but springing from a kind of stolon or living thread spreading over stones or rock in river beds. Through Mr. Rousselet I am the fortunate possessor of a specimen of this polyzoon taken in Philadelphian waters by Mr. Potts, from and by whom the species was named. A polyzoon having many of the characteristics of the fresh-water polyzoa is the well-known form of *Bowerbankia* which seems to make the best of both worlds, being chiefly found at the mouths of rivers, in docks, attaching themselves to cables and other moorings as well as spreading themselves comfortably among the fucus and other seaweeds and, at times, the beautiful hydroid *Tubularia* upon the breakwater

at Yarmouth harbour. This is clearly a case of a species gradually accommodating itself to fresh water. A great desideratum with polyzoa is the matter of aeration. In very hot weather when a great deal of the oxygen supplied by the water plants is absorbed the polyzoa nearest the surface, in cases where the vegetation is disturbed, soon succumb, as will many of the more delicate fresh-water fishes, but where the water is in constant, though not rapid, motion as in the case of the Broads fed by the rivers they thrive well.

Another habitat for polyzoa not yet mentioned in this paper is in the piping connected with the great water-works that supply filtered water to our towns and cities. Dr. Kirkpatrick of the British Museum of Natural History, South Kensington, has written a brochure entitled the "Biology of Water-works," giving a very lucid account of the fauna as well as minute vegetation to be found in the tanks and pipes at water-works all over the country. I have had access to one or two establishments of the kind near Yarmouth, and have had ocular demonstration of the existence of polyzoa in the pipes conveying the water from the rivers or lakes to the sedimentation tanks, and even to the reservoirs containing a town's daily supply. When visiting one of these places I asked the attendant to turn on the water in one of the tanks connected with the lake supply, and with the immense jet of water thrown out of the pipe came some moss-like material which I took care to obtain samples of, and this was composed of nothing more nor less than colonies of *Fredericella sultana* and *Paludicella*. These animals love shady retreats, and almost all of them are to be found well away from the light with the exception of *Cristatella* which flourishes under almost all conditions of light and shade.

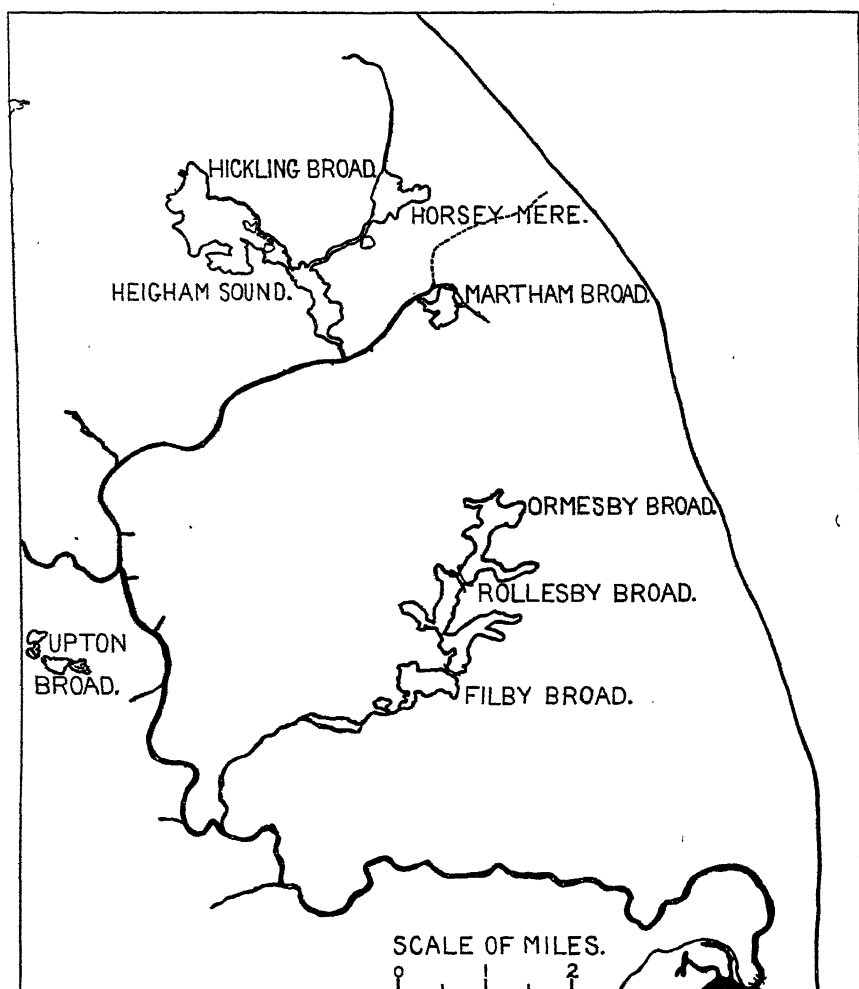
Having visited many museums and failed to find examples of the fresh-water polyzoa (although in some there are good specimens both of the marine polyzoa and of the Hydroid Zoophytes), I would suggest that curators find a little space for these charming creatures. They take up very little room, and if properly described with suitable drawings no better nor more instructive exhibits could be made. Personally I would be only too pleased to send—*con amore*—examples of most of the species to any public museum or biological laboratory.

COLLECTING AND FEEDING.

With regard to collecting polyzoa one has frequently been out with "pond-hunters" who have been very successful in collecting plankton material, but who do not seem to have acquired the knack of capturing polyzoa.

One reason has been that the right apparatus has not been used, and also that some species have so much the appearance of moss as to be taken for such.

The head of a small garden rake screwed into a landing-net stick is the best thing to use, as this will bring up all and sundry it comes in contact with. *Fredericella*, especially, has the moss aspect when seen in the water at the depth of 3 or 4 feet, and has a habit of attaching itself to the lower parts of



MAP OF NORFOLK BROADS SHOWING HABITAT OF POLYZOA.

the stems of reeds, the water iris and almost all the sedge-tribe of plants growing alongside the river banks. It will sometimes find a lodging-place in the bole of a willow tree growing so as to be partly in the water, and I have seen it in long streaming colonies attached to the free roots of this tree when the polyzoa are generally free of all river accumulations of dirt and debris. Almost invariably a few strands of *Paludicella* will be found inextricably mixed with it, the one growing around the other, but by no means as commensals. The shade-loving *Lophopus crys.* must be searched for on water-plants near the ground. It will sometimes entirely cover the under-sides of the large leaves of the water lily lying close to the bottom. *Lophopus* is really no respecter of habitats or hosts, and in propitious seasons will grow upon almost anything from the tube of a caddis-worm to the shell of a water-snail, small objects of all kinds and every species of water-plant with the exception possibly of the starwort, and I have yet to find out why this plant will not give house-room to any of the polyzoa, although the tube-building rotifer *Melicerta-ringens* is nearly always to be found upon it.

Plumatella repens is a rollicking rover in its habits and will cling and thrive upon almost anything under water, but gives preference to the all-accommodating ubiquitous water lily. *Cristatella* is the form that seems to make the most regular use of particular plants such as the potamogetons, water lily and the water soldier upon which the polyzoon simply luxuriates.

Plumatella fungosa is the most curious of all polyzoa, and it is most abundant on the free, but stiff-roots of the alder and on the more pliable subaqueous roots of the salixes, upon which it will be found in masses of from 1 inch to 8 or 10 inches in diameter.

FEEDING.

Most polyzoa can be kept alive for many weeks, and in some cases months, if careful attention be paid to feeding. If possible a little pond, or river water should be added occasionally to the tank in which they have been placed, or where this cannot be effected, anacharis leaves crushed in a mortar will produce a "soup" consisting of the liberated chlorophyll grains. This must be administered sparingly by means of a pipette, care being taken to gently stir the water two or three times a day so that the best use can be made of the food. Any suspicion of fouling in the water must be immediately remedied, either by transferring the polyzoa bodily into a clean lot of water or by carefully syphoning it off and pouring a fresh lot into the tank.

PREPARATION AND MOUNTING.

It is not at all a difficult matter to preserve these beautiful objects for museum purposes or for microscopic examination.

The first important desideratum is to get your colonies clean. Polyzoa must perforce live in an environment from which they can draw a sufficiency of suitable food, and this is on or near the mud, but they are not necessarily

dirt-loving animals. If a river is being continually churned up by motor-driven craft there will be plenty of sediment covering these delicate and fairy-like forms, but if properly and carefully treated they can be got fairly clean, and if supplied with fresh water soon after their collection will partly cleanse themselves.

In order to prepare them for examination or exhibition they should be given two or three changes of clean fresh water in the course of 24 hours. Then they should be isolated in a small glass jar or tube according to the size of the colonies and narcotizing at once started. There is nothing better for this than a 1 p.c. solution of beta eucaine as recommended for the Rotifera by the late Mr. Rousselet, and when the animals are in a comatose state they may be killed and fixed with 5 p.c. formalin, in which they should remain for another 24 hours, and then transferred to a $2\frac{1}{2}$ p.c. solution of formalin to be kept permanently in bulk or for mounting purposes. They are most satisfactory as microscopic specimens, and are easily mounted in fluid in sunk 3 by 1 slips, and if the fluid ($2\frac{1}{2}$ p.c. formalin) is given a slight dash of glycerine and allowed to be digested, the objects will have that hyaline appearance that they have in life. Most of the older mounts were in from 5 to 10 p.c. formalin without the addition of glycerine, and looked like marble effigies rather than the life-like specimens to be seen mounted in the new media. The most permanent way of mounting the polyzoa is undoubtedly in canada balsam, but it requires any amount of patience and a great deal of time and attention to get the best results. Lophopus lends itself best to this style of mounting, and in all cases it is necessary to stain the polypides either with hematoxylin or in carmine. In order to do this successfully every care must be taken that the dehydration is absolute. When the Colonies have been selected and rendered free of dirt, spirit (industrial will do) should be added to the water drop by drop until all water has been expelled. This should be followed by clearing in terpineol which must also be used gradually and allowed to clear. When this has been effected the clearing fluid must be drained off and xylol balsam substituted a drop at a time, but only enough just to cover the object when it should be put on one side under cover for 12 hours and a drop or two more of the balsam applied and again allowed to rest. In the course of two or three days the cell will be sufficiently full, and the balsam sufficiently hard for the cover-glass to be put on and the slide set aside for any length of time to thoroughly dry before the ringing process. By this means some very beautiful and highly instructive slides may be added to one's collection, and type slides be kept for general use.

IX.—CRYSTALLISATION OF SILVER BEADS AND DETECTION OF THE PLATINUM METALS BY THE MICROSCOPE.

By PROFESSOR C. O. BANNISTER, M.Eng., A.R.S.M., F.I.C.

(Read at the LIVERPOOL CONFERENCE, March 31, 1927.)

TWO PLATES.

It has long been known that the presence of certain platinum metals in silver cupellation beads causes a surface crystallisation visible to the naked eye, but the possibility of recognising the metal present by the microscopical structure of the surface has not been fully appreciated.

The presence of certain of the metals can be detected by means of the microscope, even when present in quantities far below those necessary to give crystallisation visible to the naked eye.

The method used in the production of the figures reproduced possesses one great advantage over ordinary methods used for the examination of specimens of metals and alloys in that no tedious polishing, etching or other preparation of the surface is necessary before the examination is made.

The beads are made by the ordinary cupellation of the metals with metallic lead on a porous cupel, during which operation the lead is oxidised, removed by absorption in the cupel, and the bright bead remaining is allowed to cool and is then ready for examination.

Fig. 1 (Plate XV) shows the nature of the surface of pure silver beads obtained by cupellation. A great variation of the structure is found on different beads and even on different parts of the same bead, but all the structures consist of the familiar arrangement produced by the interrupted growth of crystals of the cubic system.

In the case of pure gold, crystallisation is generally shown from very definite centres, and in some cases the growth from these centres proceeds regularly to a considerable distance before being retarded by interference from the other crystal centres.

Fig. 2 (Plate XV) shows the growth of the crystals and the regularity of the development. As a general rule gold beads show a greater interference than shown in this case.

When as little as 0.3 p.c. platinum is found in the silver bead, a distinct type of crystallisation is developed. There is a tendency for the boundaries of the crystals to become distorted, and a banded structure is developed

which, with increasing platinum, becomes more and more marked until the original structure is obliterated. Fig. 3 (Plate XV) shows the effect of the presence of 0·3 p.c. of platinum.

When additions of iridium are made to cupellation beads of silver, the resulting beads are much more spherical in shape, indicating that this metal has had an effect on the surface tension of the metal. On examination by the microscope, crystal boundaries are visible, but each crystal face is covered with a number of more or less straight lines running in different directions and crossing each other after the manner of slip bands.

In every case of beads containing iridium these marks were present sufficiently clearly to indicate the presence of *iridium*. In no other cases, except with osmiridium, were these marks persistent. Fig. 4 (Plate XV) shows the effect of 1 p.c. iridium.

With traces of rhodium, such as 0·004 p.c., a distinct crystallisation of the silver is caused, each crystal face being frequently covered with parallel straight lines. The effect of 0·01 p.c. rhodium is illustrated in Fig. 5 (Plate XVI).

With additions of ruthenium the markings on the crystal faces have a single-sided herring bone structure, and this structure has only been met with otherwise in a few cases in which the silver has been cupelled with osmium. In the presence of ruthenium, however, there is always a further indication present as even with 0·004 p.c., there is a small amount of black deposit near the bottom of the bead. Fig. 6 (Plate XVI) shows effect of 0·5 p.c. ruthenium.

Palladium unfortunately gives beads similar to those due to platinum, but on solution in nitric acid the former metal gives a distinctly yellow solution. Fig. 7 shows the effect of 2 p.c. palladium.

EXPLANATION OF PLATE XV.

- Fig. 1.* Crystallisation of pure silver.
Fig. 2. Crystallisation of pure gold.
Fig. 3. Crystallisation of silver containing 0·3% platinum.
Fig. 4. Crystallisation of silver containing 1·0% iridium.

EXPLANATION OF PLATE XVI.

- Fig. 5.* Crystallisation of silver containing 0·01% rhodium.
Fig. 6. Crystallisation of silver containing 0·5% ruthenium.
Fig. 7. Crystallisation of silver containing 2·0% palladium.



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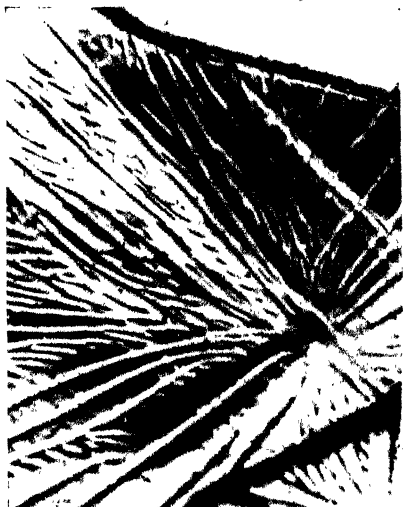
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OBITUARY.

THE death of Dr. Corrado Da Fano on March 14th, 1927, has removed one of the few distinguished histologists working in this country. Dr. Da Fano was born in 1879 at Urbino. He was educated in Milan and Paris where he obtained his medical education, becoming M.D. in 1905. His initiation into neuro-histology and histo-pathology in the institute of Camillo Golgi gave a trend to his whole life work, and his death has followed close on that



CORRADO DONATO DA FANO.

of his master. He studied in Ziehen's laboratory at Berlin and thereafter (1909) in the laboratory of the Imperial Cancer Research Fund under Dr. Bashford, where I first met him. The friendship which then began was maintained till his decease. From London he passed to Gröningen, where he acted as assistant to Professor Reddingius for a year. He returned to Milan and became *Libero docente* in 1912.

During the great war he served as Captain in the Italian R.A.M.C. In

1918 he settled in London as lecturer (and later reader) in histology in the University of London at King's College. He joined the Royal Microscopical Society in 1920, and soon was appointed to the Council. He threw himself with all his energy into the exacting labour of editing the Zoological Abstracts for the Journal, preparing many of them himself. He was elected Vice-President in January of this year, only three months before his death.

His scientific output, published in sixty papers, was enormous, and although mainly concerned with the cytology and histo-pathology of the nervous system, and the details of the Golgi apparatus in other cells, extended to such widely separated themes as the histological analysis of the mechanism of resistance to transplantable tumours, the growth of these tumours in the central nervous system, and the lesions of encephalitis lethargica on which he was engaged at the time of his death. To all his problems he brought a technical perfection, acquired in the exacting realm of the microscopic anatomy of the nervous system, which made habitual with him the most painstaking exactitude both in the technical and descriptive aspects of his work. In addition he was himself a consummate artist as is clearly exemplified in the figures which he himself executed or supervised.

His encyclopædic knowledge of neurological technique was always at the service of others. In addition to his contributions to the Journal of the Royal Microscopical Society he acted as one of the Editors of Physiological Abstracts, his knowledge of European languages assisting greatly in ensuring the completeness of the review of current researches in that Journal.

It would be unworthy for me to attempt to pass the judgment of posterity on Da Fano's work. His enthusiasm, his industry and his kindness endeared him to those who were privileged to know him well. His sustained veneration, unaffected and sincere, for his master, Camillo Golgi, was one of the dominating influences in his life.

J. A. MURRAY.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

STAINING AND IMPREGNATION METHODS.

A Method of Rendering Ultra-Microscopic Elements Visible.—H. BECHHOLD and VILLA ("Die Sichtbarmachung subvisibler Gebilde," *Centralbl. f. Bakt.*, 1926, 97, 162). The liquid containing the ultra-microscopic particles is treated with gold chloride and freed from an excess of the reagent by ultra-filtration. A small quantity of the liquid thus obtained is spread on a slide and passed through the flame. The gold chloride fixed on the ultra-microscopic particles is reduced to the state of metallic gold. The slide is then treated with formaldehyde in an alkaline solution followed by potassium ferricyanide, which only allows the gold to remain fixed on the ultra-microscopic particles. On examination with the ultra-microscope ultra-microscopic elements in vaccinia can be demonstrated. The molecule of albumin is between 4 and $10\ \mu\mu$. The bacteriophage is from $35\ \mu\mu$ to $100\ \mu\mu$.
G. M. F.

Vital Staining of the Golgi Apparatus.—PH. JOYET-LAVERGNE ("Sur la coloration vitale au rouge neutre des éléments de Golgi des Grégarines," *C. r. Soc. de Biol.*, 1926, 94, 830). The Golgi apparatus can be stained with neutral red in *Gregarina cuneata*, *G. polymorpha* and *Stenina molitor*.
G. M. F.

Eosin Dyes—Standardisation.—H. J. CONN ("Progress in the Standardisation of Stains. The Standardisation of Eosin and Related Dyes," *Stain Technology*, 1926, 5, 1). The dyes of the eosin group have been very hard to standardise. In this group there are a very large number of different compounds theoretically possible and various mixtures of them may occur; further difficulty arises from the fact that the different members vary so slightly from one another in their staining properties that it takes a long investigation to show whether any particular type is better for a given purpose than some other type. Recent investigations of the Commission on Standardization of Biological Stains show that the dyes of this group available before the war which are of most importance to biologists are: eosin Y, ethyl eosin (generally called alcohol-soluble eosin), eosin B, erythrosin, phloxine, and rose bengal. All of these are now available among the products of domestic manufacture except ethyl eosin, and that is shortly to be put on the market. Of these dyes, eosin Y, ethyl eosin, and eosin B are particularly valuable as diffuse counter stains (generally in alcoholic solution) following basic dyes; erythrosin, phloxine, and rose bengal, on the other hand, are more useful in aqueous solution preceding a basic dye. In the base of each of these two types of procedures, the particular dye to choose depends undoubtedly upon the exact shade desired.
G. M. F.

Iron Hæmatoxylin and Neutral Red.—L. O. MORGAN ("Iron Hæmatoxylin as a Myelin Sheath Stain and Neutral Red Ripened by Colon Bacillus as a Nerve-Cell Stain," *Anat. Rec.*, 1926, **32**, 283-94, 1 pl.). A modification of the iron-hæmatoxylin staining method followed by counterstaining with neutral red ripened by *B. coli* is advocated, particularly for serial sections of the central nervous system. The procedure should be as follows: Fix in alcohol, formalin, formol alcohol or in the mixtures of Flemming, Carnoy, or Bouin; dehydrate and embed either in paraffin or celloidin. Mordant the sections two hours or less in 4 p.c. iron alum, wash, stain 3-8 hours in $\frac{1}{2}$ p.c. well-ripened hæmatoxylin. Differentiate in 2 p.c. iron alum until the larger fibre tracts are well outlined, wash. Complete the differentiation, if necessary, by placing the sections in $\frac{1}{2}$ p.c. HCl for a few seconds. Counterstain with neutral red, differentiate with alcohol, clear in xylol, and mount in balsam. To ripen the neutral red, a 1 p.c. solution is inoculated with *B. coli* and incubated at 37° C. for 2-3 days. The stain can be diluted at the moment of use to $\frac{1}{2}$ or $\frac{1}{4}$ p.c.; it should be warmed. Differentiate with 75 p.c. alcohol. C. D. F.

The Fixation of Tissues.—M. A. VAN HERWERDEN ("Reversible Gelation and Fixation of Tissues," *Proc. K. Akad. Wetensch.*, 1926, **29**, 975-978). It is suggested that histological fixation involves an irreversible coagulation, but that there is a gradual transition reversible through a gelation of protoplasm to complete fixation. If *Paramœcium aurelia* is kept in 1 p.c. formaldehyde, death results; but in 0.01-0.1 p.c. solutions a solidification occurs, which is not a fixation, but a reversible gelation, since conditions return to normal after washing the animals in ditch water. Similarly, the Brownian movement of another protozoon, *Actinophrys sol*, is stopped by adding a 0.01 p.c. formaldehyde solution and completely restored after rinsing it in water. G. M. F.

GENERAL CYTOLOGY.

Mitosis in the Skin of Mammals.—R. T. HANCE ("A controllable Source of Mitoses in Mammals," *Trans. Amer. Micr. Soc.*, 1927, **46**, 66-8, 1 text-fig.). Shaving the hair from the abdomen of mice is followed in from 8 to 12 days by an epidemic of mitoses in the cells of the hair follicles. The mitotic activity returns to normal in a little more than two weeks. G. M. F.

Penetration of Dyes.—M. IRWIN ("Effects of Salts on the Penetration of Brilliant Cresyl-Blue into Nitella," *J. Gen. Physiol.*, 1927, **10**, 425-436). Cells of *Nitella* previously exposed to solutions of salts containing univalent cations are penetrated less readily by brilliant cresyl-blue when subsequently immersed in a solution of this dye in a borate buffer mixture. Salts with bivalent and trivalent cations do not produce this effect, but rather neutralize the effect of the univalent cations. G. M. F.

Infective Myxomatosis of the Rabbit.—T. M. RIVERS ("Changes Observed in Epidermal Cells Covering Myxomatous Masses induced by Virus Myxomatosum (Sanarelli)," *Proc. Soc. Exp. Biol. & Med.*, 1927, **24**, 435-437). Sanarelli (1898) described an infectious myxoma indigenous to rabbits of South America and due to a filterable virus. Tumour-like masses appear quickly at the site of inoculation and later at various other points in the subcutaneous tissue as well as in the lymph nodes and spleen. Both epithelial and connective tissues are affected. On the one hand there is a proliferation of certain cells within the connective tissue, on

the other a destruction of epithelial cells is occurring. In epidermal cells fixed in Zenker's fluid plus 5 p.c. acetic acid and stained with eosin and methylene blue the following changes are noted. First there is an increase in the size of the epidermal cells. Pink acidophilic masses appear in the cytoplasm and frequently involve the greater part of the cytoplasm. In the centre of the acidophilic masses blue round or rod-shaped bodies are found. The nature of the acidophilic masses in the epidermal cells is unknown.

G. M. F.

Secretion in the Cells of the Egg Follicle of the Cricket.—M. E. MURRAY ("Secretion in the Amitotic Cells of the Cricket Egg Follicle," *Biol. Bull.*, 1926, 50, 210–234, 3 pls.). Study of cell division in the "amitotic" follicle cells of the cricket has shown that in this form the division of the nucleolus and the constriction of the nucleus are rarely if ever followed by the constriction and division of the cytoplasm. The amitotic behaviour of the nucleus is not regarded as an indication or result of senescence, but as playing some part in the intense secretory activity of the cell by an increase of nuclear and nucleolar surface. Droplets of a fatty nature are elaborated by the follicle cells and passed in large numbers into the hæmocoel of the insect. The mitochondria of the follicle cells represent an intermediate stage between lipid granules appearing in the nucleus of the follicle cell and lipid granules surrounding the yolk globules of the egg. No inclusions corresponding entirely to current descriptions of Golgi bodies have been observed in egg or follicle cell.

G. M. F.

Cytoplasmic Inclusions in the Sperm of Helix.—L. KARPOVA ("Beobachtungen über den Apparat Golgi (Nebenkern) in den Samenzellen von *Helix pomatia*," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). In the living sperm cells dictyosomes and mitochondria stain with janus green and dahlia violet. There are present also vacuoles which stain with neutral red and which correspond to the vacuolar system of Guillermond, Parat, etc. They form the archoplasm of fixed preparations and contain lipoids. The only essential differences between dictyosomes and mitochondria are that the former are impregnated a deeper black with osmium and silver, than are the latter, and each dictyosome is usually accompanied by archoplasm, whereas the mitochondria are not. Hence the dictyosomes are probably mitochondria which are occupied at the time in secretion formation.

L. A. H.

Activity of Cells in Tissue Culture.—E. N. WILLMER ("Studies on the Influence of the Surrounding Medium on the Activity of Cells in Tissue Culture," *Brit. J. Exp. Biol.*, 1927, 4, 280–291, 1 pl. and 7 text-figs.). A suitable saline medium for the survival of intestinal tissues from the embryo chick was found to be the following: NaCl 0.8 p.c., KCl 0.025 p.c., CaCl_2 0.025 p.c., NaHCO_3 0.02 p.c., glucose 0.8 p.c. In this medium the concentration of NaCl could be varied from 0.4 p.c. to 1 p.c. and still allow of an active migration of cells to take place. Outside these limits migration occurred fairly freely as far as 0.2 p.c. and 1.2 p.c., but was then either reduced in extent or abnormal in character. When the concentration of NaCl was low the cells became abnormal and vacuolated probably owing to low osmotic pressure. Fibroblasts grew most extensively when the sodium chloride concentration was 0.7 p.c. This was considered to be due to the stimulus given to amoeboid movement by hypotonic solutions. For good epithelial growth a salt concentration of 0.9 p.c. was found to be most satisfactory. Glucose was found to be a necessary constituent. Above a concentration of 1 p.c. it became toxic.

G. M. F.

Absorption of Vital Stain by Connective Tissue Cells.—L. LEPPER ("Vitalfarbungsversuche an überlebenden Bindegewebszellen," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). The histiocytes of the frog in isolated pieces of connective tissue placed in a solution of trypan blue in Ringer-Locke solution, and also of frogs injected with the above solution, absorb the stain, which is deposited as granules in their cytoplasm. Those of the dog, on the other hand, whether in isolated pieces of connective tissue, or in injected ears, do not absorb the stain at all. On cultivation of the tissue on blood plasma, the histiocytes absorb the stain and it is deposited as granules in their cytoplasm. Placing connective tissue of the dog in trypan blue solution modifies but does not kill the cells, for they will grow in blood plasma cultures after being submitted to the solution, and the histiocytes then acquire the power of absorbing the stain. This power depends on external factors, such as the presence of albumin in the blood plasma. L. A. H.

Methylene Blue and Living Cells.—M. IRWIN ("Does Methylene Blue penetrate into Living Cells?" *Proc. Soc. Exp. Biol. & Med.*, 1927, 24, 425-426). Experiments with dyes tend to favour the theory that the penetration of a basic dye into living cells depends on the fact that the dye has an apparent dissociation constant and that in the form of free base which predominates at higher pH values it penetrates very readily, while in the form of salt it penetrates so slightly that its entrance may be neglected. According to this theory methylene blue which behaves like a strong base should not penetrate since it exists in the form of a salt. Although living cells are said to have been stained with methylene blue no one has actually tested the dye which has actually entered a living cell from a solution of methylene blue. The evidence brought forward suggests that the dye taken up by living cells is really trimethyl thionin. G. M. F.

Bacterial Infection and Growth of Connective Tissue Cells.—M. T. BURROWS ("The Overgrowth of the Connective Tissue Cells in Infected Wounds," *Proc. Soc. Exp. Biol. & Med.*, 1927, 24, 495-496). The effect of bacteria of various kinds on the growth of heart muscle cells *in vitro* was studied. The cultures were prepared by placing fragments of heart muscle into layers of plasma which clotted about them. Non-liquefying cultures of bacteria growing in such cultures can inhibit the growth of the heart muscle cells for a distance of not more than 0.55 mm. In cultures of tissues containing bacteria which liquefy the medium the inhibiting substances diffuse with the ferment which dissolves the clot. They may also diffuse from the liquefied zone for a distance of 0.5 mm., but, as a rule, they do not penetrate the clot to so great a distance. Fresh sterile fibrin in a wound may thus be an effective barrier against the action of bacteria on the cells since a layer of fibrin greater than 0.5 mm. in thickness can protect the cells from the action of any bacteria which do not grow and invade the exudate faster than it is being laid down anew by the blood vessels. G. M. F.

Movements of Sarcoma Cells Cultivated in Vitro.—A. POLICARD ("Les mouvements des cellules sarcomateuses cultivées in vitro," *Compt. rend. Acad. d. Sc.*, 1926, 182, 168-70, 2 text-figs.). The cells of a rat sarcoma of the Jensen type show, when cultivated in vitro, incessant and very rapid amoeboid movements which manifest themselves through the emission and retraction of pseudopodia, while the actual displacement of the cells is rather sluggish. The apparent contradiction is due to the fact that the pseudopodia are of two kinds: granular, or endoplasmic and hyaline, and only the latter are able to adhere to the glass and consequently favour the displacement of the cells. C. D. F.

Initial Growth of Tissue Cultures: Influence of Heterologous Embryonic Juice.—L. KAUFMAN ("Effet du jus embryonnaire hétérogène sur la rapidité d'émigration des cellules et les premiers stades de croissance des cultures de tissus," *Compt. rend. Acad. d. Sc.*, 1926, 183, 370–3). The initial growth of the heart of the chick cultivated *in vitro* is considerably more rapid if some juice from duck embryos is added to the culture. This effect appears to be due to the fact that the normal development of the duck is more rapid than that of the chick. Also the cells of the chick's heart seem larger when cultivated *in vitro* under the above conditions than when cultivated with the addition of an extract of chick embryo. C. D. F.

VERTEBRATA.

General.

Vasodilation in Fundulus.—C. J. CONNOLLY ("Vasodilation in Fundulus due to a colour stimulus," *Biol. Bull.*, 1926, 50, 207–209). Fundulus placed in fresh water exhibits a red colouration due to marked vaso-dilatation, but in salt water this change is partly inhibited. Injections of adrenalin produce a temporary constriction followed by a marked vaso-dilatation. G. M. F.

Leucocyte Tides.—A. F. B. SHAW ("The Diurnal Tides of the Leucocytes of Man," *J. Path and Bact.*, 1927, 30, 1–19). During a twenty-four hours day the total leucocytes of man exhibit two tides each occupying approximately twelve hours. The day tide begins in the forenoon, reaches its flood during the afternoon, and completes its ebb in the evening. The night tide starts in the evening, attains its height in the hours after midnight, and ebbs away in the early forenoon. The day and night tides occur regardless of food, exercise and sleep and do not appear to be influenced by them. The curve of the total neutrophil leucocytes closely follows the course of the tides, and is largely responsible for the characters of the latter. The total numbers of the lymphocytes and other cells do not follow the tidal curve. G. M. F.

Micrometry of Red Blood Corpuscles.—S. JORGENSEN and E. J. WARBURG ("The Indices and Diameters of the Erythrocytes and the best Hæmatological Criterion of Pernicious Anæmia," *Act. Med. Scand.*, 1927, 66, 109–186). This long paper is primarily of clinical interest, but contains a careful and critical discussion of the micrometry of the erythrocytes with a truly formidable bibliography of the work of other microscopists. The authors do not accept the mean diameter of 8.8μ arrived at by Ponder and Millar from photographic measurements, and after discussing the differences of technique which have led to discrepancies in the mean diameters given by others, they state that they believe the true figure to be 7.7μ , which is the diameter most frequently arrived at by former students of wet preparations. They express themselves as very satisfied with the accuracy of graduation of both stage and ocular micrometers. The relation of diameter to volume is fully considered, and the steps are set out whereby the conclusion is reached that if 15 p.c. of the erythrocytes have a diameter greater than or equal to 8.6μ there is strong suspicion of pernicious anæmia, and that this forms the best hæmatological criterion whereby this disease may be distinguished from other severe anæmias. J. F. C. H.

A. VERTEBRATA.

Embryology, Evolution, Heredity, Reproduction.

Genetic Studies in Poultry.—W. V. LAMBERT and C. W. KNOX ("Genetic Studies in Poultry," *Biol. Bull.*, 1926, **51**, 225-236). The sex ration for 2,910 chicks and embryos examined was 51.13. The sex ratio for total living chicks was 50.97, for embryos dying between the eighteenth and twenty-first days of incubation 50.06, and for embryos dying between the twelfth and eighteenth days 55.82 p.c. No tendency for an increase or a decrease in the sex ratio as the hatching season progressed was noted. The sex ratio of hybrid birds is approximately the same as that of the pure breeds observed. No relationship between the sex ratio and the factors of mean individual egg weight, antecedent egg production and actual egg production during the hatching season is apparent.

G. M. F.

Accessory Structures in the Porpoise Testis.—C. PING ("On the Testis and its Accessory Structures in the Porpoise," *Anat. Rec.*, 1926, **32**, 113-17, 2 text-figs.). Owing to the large number of lobules in the testis of the porpoise (*Neomeris phocaenoides*), the septa are more numerous than those found in the usual mammalian testis, and the rete testis is thus evenly distributed throughout the generative organ, and the absence of the mediastinum does not result in any functional defect. The vasa efferentia are small, but the complicated epididymis probably assists in passing spermatozoa in normal rate and manner. Likewise the much convoluted vas deferens supplements the function of the single and little developed vesicula seminalis.

C. D. F.

Eggs and Young of Blennies.—M. V. LEBOUR ("The Eggs and Newly-Hatched Young of the Common Blennies from the Plymouth Neighbourhood," *J. Marine Biol. Assn.*, 1927, **14**, 647-650, 1 text-fig.). The three common blennies of Plymouth are *Blennius pholis* L., *B. gattorugine* L., and *B. ocellaris* L., all of which have different habitats. The eggs of *B. pholis* and *B. ocellaris* have frequently been found and hatched out, but those of *B. gattorugine* have up to the present time not been identified. The eggs of *B. gattorugine* are black and purple like those of *B. pholis*, but the diameter is slightly larger than that of *B. pholis*, being 1.6 mm. The newly hatched fish measures 4.9 mm. in length. All the three blennies can be identified from the egg and first larval stages.

G. M. F.

Parthenogenesis in Sea Urchins.—M. M. SAMPSON ("The Parthenogenetic Effect of Sperm Filtrates, Concentrated Sperm Suspensions and Serum of Chitons on the Ova of the Sea-Urchin *Strongylocentrotus franciscanus*," *Biol. Bull.*, 1926, **50**, 202-206). Ova of *S. franciscanus* exposed to sperm filtrates, concentrated sperm suspensions, or to blood serum of *Katharina tunicata* for one to three minutes formed typical fertilization membranes. Subsequent treatment with Loeb's hypertonic sea-water for seventy minutes caused a large percentage of those with membranes to develop into gastrulæ and plutei. Every precaution was taken to avoid contamination of the sperm suspensions of the chiton with body fluids or serum. It seems probable that the membrane formation in the filtrates and in the concentrated sperm suspensions is due to some substance derived from the sperm. The nature of this substance has not been determined. Experiments with filtrates of sperm of *Arbacia*, *S. purpuratus*, *S. franciscanus* and *Nereis*, indicate that it is an organic compound. The effect produced by the serum is probably due to organic

compounds present in the latter. Similar results were obtained with ova of *S. franciscanus*, which were treated with concentrated sperm suspensions and with dilute serum of two other chitons, *Ishnochiton magdalensis* and *Cryptochiton*. With ova of *S. purpuratus* no typical membranes formed, and the fertilization capacity of the treated eggs appeared to be normal.

G. M. F.

Sperm Filtrates.—M. M. SAMPSON ("Sperm Filtrates and Dialyzates," *Biol. Bull.*, 1926, 50, 301-338, 2 text-figs.). Solutions obtained by filtration and dialysis of suspensions of living sperm in sea water activate ova of the same species. Tests indicate that the effect is produced by some substance derived from the sperm and not by some extraneous parthenogenetic factor. Ova of *Nereis* exposed to specific sperm filtrates form fertilization membranes, complete their maturation, and some develop into abnormal trochophores. Ova of sea-urchins fail to form membranes, but do undergo nuclear and cell division. Ova exposed to filtrates and dialyzates are more susceptible to the action of hypertonic sea-water and to the entrance of sperm. In normal fertilization sperm exposed to "fertilizin" undergo profound modification in chemical structure and organization, and unless such modification occurs the sperms fail to fertilize the egg even though they may enter it. It is possible that substances localized in the surface of the sperm head activate the ovum. Such localization is transitory.

G. M. F.

Sole Patterns of Twins.—R. B. MONTGOMERY ("Sole Patterns of Twins," *Biol. Bull.*, 1926, 50, 293-300, 1 text-fig.). The presence of identical patterns on the soles of a pair of twins points to their monozygotic origin, but their absence does not disprove such an origin.

G. M. F.

The Conditions Governing Parturition.—F. H. A. MARSHALL ("The Conditions Governing Parturition," *Biol. Rev.*, 1927, 2, 129). After a timely warning against the expectation that physiological mechanisms will necessarily be perfect, Dr. Marshall proceeds to consider the various groups of facts which bear upon the conditions governing parturition. In this connection the condition known as pseudo-pregnancy is among the most suggestive. This condition is known to occur in the marsupial cat, the opossum, the dog, and in the rabbit under experimental conditions. In these animals the corpus luteum of ovulation persists in much the same manner as during gestation, and the uterus and mammary glands undergo hypertrophy in correlation with this development of the corpus luteum. The evidence that these changes are due to the development of the corpus luteum is quite definite. At the end of pseudo-pregnancy the corpus luteum undergoes involution, and in correlation with this many phenomena normally associated with parturition are found. Thus the rabbit and the bitch will prepare a nest as though for a litter, and the marsupial cat cleans out her pouch as though for the reception of young. These habits are displayed at the end of pseudo-pregnancy, and since this is dependent upon the persistence of the corpus luteum, it is not unreasonable to suppose that the phenomena associated with true parturition are also dependent upon the corpus luteum. It may thus be supposed that parturition is brought about by the attainment by the ovary of a certain stage of its cycle. Since, however, it has not been found possible to demonstrate a specific action by ovarian extracts on uterine contraction, it is necessary to suppose that some other factor is involved in the actual production of parturition. In this connection experiments on the effect of ovarian extracts on the activity of the pituitary gland are of considerable importance. It is, of course, well known that the pituitary secretion has a specific action in promoting uterine contraction, and

if the ovary towards the end of pregnancy exerts a stimulating action upon the pituitary, the onset of parturition would be facilitated. While it is fairly certain that such a mechanism could not supply a complete interpretation of the facts to be explained, there is additional evidence that one factor at least in the causation of parturition is an ovarian-pituitary mechanism. A. S. P.

The Genes in Spermatozoa.—H. J. MULLER and F. SETTLES ("The Non-functioning of the Genes in Spermatozoa," *Zeit. für ind. Abstammungs-u. Vererb.*, 1927, 43, 285). Ageing of the spermatozoa of *Drosophila* does not appreciably affect the ratio of sperms of different types. This applies both in comparison of sperm of normal constitution with those of abnormal constitution, and also the persistence of the normal ratio of X-spermatozoa and Y-spermatozoa is found. X-irradiation of spermatozoa while in the female genitalia also produces no appreciable disturbance, though the resulting sex-ratio may be slightly altered in the direction of female excess. A. S. P.

Thyroid Feeding and Chicks.—H. B. TORREY and B. HORNING ("Thyroid Feeding and Secondary Sex Characters in Rhode Island Red Chicks," *Biol. Bull.*, 1925, 49, 365). Male Rhode Island Red Chicks were fed a dried preparation of thyroid gland in doses increasing with their weight. The general effect of this was that the plumage assumed certain features characteristic of the female. The plumage appeared precociously at the beginning, but the sexual differentiation in the plumage took place later than is customary. Since this differentiation largely consists in the assumption of the typical male characters, the initial effect of thyroid feeding was that the male chicks at twelve weeks old had the spurious appearance of females. Subsequently their plumage when adult became prevaillingly male in type, but certain characteristics of form and structure, which are normally only found in the females were found to be present, notably in the hackle, saddle, back and shoulder feathers. The authors conclude that thyroid feeding tends to produce hen feathering in the male of the Rhode Island Red, and that this result is produced independently of gonad activity. A. S. P.

Inheritance in Sheep.—C. B. DAVENPORT and E. G. RITZMAN ("Some Wool Characters and their Inheritance," New Hampshire Agricultural Experiment Station, *Tech. Bull.*, 1926, No. 31). The characters of 338 sheep hybrids (1 Hampshire ram, 3 Southdown rams, 1 Rambouillet ram crossed with 53 Rambouillet ewes and 28 Oxford ewes) were studied in relation to fleece weight and diameter, length, and crimp of wool. In studying the inheritance of these characters, due allowance was made for environmental influence, and for the effect of the age and weight of the animal. In Rambouillet-down cross the fleece resembles more nearly that of the down parent. The hybrids lose the highly selected weight of the Merino fleece, but this defect can, however, be remedied by selection, fairly obvious segregation taking place. The grease content of wool depends so much on environment that its inheritance could not be satisfactorily determined. The wool diameter, however, was clearly influenced by heredity, the hybrids in most cases being intermediate in type, and very variable. Crimpness of wool in the crosses was also intermediate between that of the parents, though there was on the whole a tendency for the hybrid to take after the more crimply parent, which appears to indicate an imperfect Mendelian dominance on the part of crimpiness. Crimpiness in sheep is apparently inherited like curliness of hair in sheep or in man. There is no significant correlation between crimpiness and wool diameter, but there is a correlation between crimpiness and wool length. A. S. P.

Studies in Mammalian Spermatogenesis.—T. S. PAINTER (III. "The Fate of the Chromatin Nucleolus in the Opossum," *J. Exp. Zool.*, 1924, **39**, 197–228). The testes were fixed in Allen's modification of Bouin's fluid. Various methods of staining were tried, but the most satisfactory results were obtained with iron hæmatoxylin and especially with safranin followed by gentian violet. Chromatin-nucleoli can be found both before and after synizesis, but cannot be traced continuously through this process owing to the intense staining of the pachytene threads. After synizesis the chromatin-nucleolus appears as a number of rounded masses which join to form an oblong mass, and, at diakinesis a ring which looks like a tetrad. This ring divides to give rise to X and Y chromosomes of the first maturation division.

A. D. H.

Studies in Mammalian Spermatogenesis.—T. S. PAINTER (IV. "The Sex Chromosomes of Monkeys," *J. Exp. Zool.*, 1924, **39**, 433–462). The species studied were the Brown Cebus Monkey, representing the New World type, and *Rhesus macacus*, representing the Old World monkeys. The fixative employed was Allen's modification of Bouin's fluid and iron hæmatoxylin was used for staining. In the Brown Cebus monkey the diploid number of chromosomes is 54. There is an X and a Y chromosome which can be easily distinguished while segregating on the spindle of the first maturation division. In *Rhesus macacus* the diploid chromosome number is 48. The X and Y chromosomes are present and are essentially similar to those in the Brown Cebus, except that the X chromosome is rod-shaped instead of bent. The Y chromosome is small and round in both species. The identification of the sex chromosomes has been confirmed in *Rhesus macacus* by examination of somatic cells of embryos. In a late male embryo the chromosome number was found to be 48 including a Y chromosome. In two embryos too young for the sex to be distinguished, the somatic number was 48, but in no case could a Y chromosome be found. Hence it is concluded that these were both females. The sex chromosome of these two species of monkeys are compared with those identified by the author in the opossum and in man and their essential similarity pointed out.

A. D. H.

Studies in Mammalian Spermatogenesis.—T. S. PAINTER (V. "The Chromosomes of the Horse," *J. Exp. Zool.*, 1924, **39**, 229–247). The testes were fixed in Allen's modification of Bouin's fluid. The sections were stained in iron hæmatoxylin and safranin and gentian violet. The diploid chromosome number is probably 60, though this is not absolutely certain. The chromosomes are, on the whole, very small and rod-shaped and are consequently difficult to count. In one of the largest pairs of chromosomes each consists of two parts joined by a fine bridge of chromatic material. The author suggests that the condition found in the horse of a large number of very small chromosomes may have arisen by fragmentation of an originally smaller number of large chromosomes. The sex chromosomes are recognisable at the first maturation division and are of the X-Y type, not of the X-O type as described by Wodsalek. The X and Y chromosomes can be seen in the early stages of the division lying on the spindle united by a thick chromatic bridge which becomes finer as the two chromosomes migrate to the opposite poles.

A. D. H.

VERTEBRATA.

Histology.

Intestinal Glands of Necturus.—A. B. DAWSON ("On the of Rôle the So-called Intestinal Glands of Necturus with a Note on Mucin Formation," *Trans. Amer. Micr. Soc.*, 1927, **46**, 1–14, 3 pls.). A study of the so-called intestinal

glands of *Necturus* was made on freshly caught animals as well as on those which had fasted for from 5-11 months. No essential differences were noted in the two groups. These masses of cells are primarily centres of cell proliferation. Elaboration of mucin may begin and proceed to varying stages, dependent on the mitotic activity within the mass and the need of cells in the superficial epithelium. Temporary lumina may appear within the masses and the cells may, at these times, exhibit a decided polarity. No ducts are present and secretion is never discharged directly upon the intestinal surface. Mucin, elaborated within such cells, will not be discharged until they come to occupy a definite position, as goblet cells, within the columnar epithelium. The masses vary greatly in size and possibly are not permanent structures, but may exist only for a period and be replaced by new down growths from the superficial epithelium. These structures are probably homologous with the intestinal crypts of the higher vertebrates.

G. M. F.

Cells in the Dentine of Elasmobranchia.—J. THOMASSET ("Sur la présence des cellules dans la dentine de quelques élasmodontes," *Compt. rend. Acad. d. sc.*, 1926, **182**, 1644-7). Spaces evidently left by odontoblasts are described in the peripheral substance of fossil and dried teeth of Selachians. They are rounded, 25-40 μ long, and have each a prolongation up to 300 μ long toward the edge or point of the tooth. They occur only near the points and edges, are numerous on the projections in notched teeth, and are found usually on the concave edge of curved teeth. In the Lamnidæ these cells, present in the substance covering the osteodentine, are described in *Lamna*, *Carcharodon Rondeleti*, and *Corax*. In the Carchariidæ, whose teeth have no osteodentine, they are described in *Galcoacordo*, *Hemipristis* and *Carcharias*. Among other families they are recorded in *Acanthias*. The presence of these spaces near the points and edges of teeth is due to the fact that the two planes, in which the layers of odontoblasts parallel to the inner and outer surfaces of the teeth lie, intersect in these regions, so that the arrangement of the odontoblasts is irregular. Thus the withdrawal of some of these cells from the region of calcification is hindered. The presence of cells proves that the substance covering the osteodentine of Lamnidæ is true dentine. In the Carchariidæ the outer layer may be of mixed origin. The theory of the mixed origin of the outermost vitrodentine or enamel layer of the teeth of Selachians is supported by its continuity with the true dentine, and the fact that the odontoblasts of the latter often reach out into it so probably take part in its formation.

S. D. K.

Biliary Tract of Rodents.—G. M. HIGGINS ("The Biliary Tract of certain Rodents with and those without a Gall Bladder," *Anat. Rec.*, 1926, **32**, 89-111, 9 text-figs., 2 pls.). The gall bladder develops relatively early in the embryonic life of the mouse. In a 4.2 mm. embryo it is partially canalised and is relatively large. A gall bladder or even a vestige of one was never identified in any ontogenetic stage of the rat. The hepatic ducts grow out from the antrum of the biliary diverticulum into the tissue of the liver. In the embryos of both the rat and the mouse certain of these ducts become associated with the embryonic vascular channels at an early stage, but this association is much more pronounced in rat embryos than in young mice. In a 22 mm. rat embryo hepatic ducts form a considerable plexus around the branches of the portal vein. In the mouse a pair of biliary channels follows the branches of the portal vein to the ultimate lobule. Besides these hepatic channels, an extensive plexus of small biliary ducts passes around the branches of the portal vein in the rat. They are connected with the

larger bile ducts which run parallel to the vein and may be an intrahepatic compensatory mechanism for the concentration of bile.

C. D. F.

Anal Glands of Ground-Squirrel.—G. F. SLEGGs ("The Adult Anatomy and Histology of the Anal Glands of the Richardson Ground Squirrel, *Citellus richardsonii*, Sabine," *Anat. Rec.*, 1926, **32**, 1-43, 9 pls.). In *Citellus richardsonii* three large glandular masses open upon the anal wall by evertible ducts representing invaginations of the epidermis, the stratum corneum of which is greatly thickened. The ducts are normally introverted, but when extroverted they appear as three conspicuous papillæ. The glandular masses are surrounded by a sheath of striped muscle derived from the sphincter and externus. The retraction of the papillæ is effected by plain muscle derived from the longitudinal muscle coat of the large intestine. The masses comprise two distinct histological elements both representing modified sebaceous glands, the hair follicles of which have been lost. Lobules of one type form the bulk of each gland and consist of alveoli densely filled with epithelial cells in course of desquamation. The second type of glandular tissue comprises a smaller number of lobules lying between those of the first type and the muscular capsule. Their alveoli possess an open lumen into which fluid is secreted and shells are shed from the walls concomitantly with secretion to form corpuscles which undergo degenerative changes, some of them encysting first. The ducts of these alveoli are long and branched and pass between the lobules of the first type to open to the exterior together with the ducts of the latter. Active desquamation of epithelial cells takes place in both kinds of alveoli.

C. D. F.

Calcification in the Rabbit's Brain.—C. DA FANO and J. R. PERDRAU ("Calcification in the Rabbit's Brain," *Jour. Path. and Bact.*, 1926, **29** (2), 195-202, 3 pls.). Description and discussion of an extensive process of incrustation of nerve cells and of either globular or granular deposits observed by the authors in the brains of two rabbits which, owing to partial immunity, had clinically recovered from a herpetic encephalitis. In addition in the brain of one of these two animals a few parasites of so-called spontaneous encephalitis were found though in regions entirely different from those in which the above lesions were noticed. No connexion appeared to exist between the probably accidental presence of the parasites in only one of the two rabbits and the incrustations and deposits which were confined to areas where severe destructive, infiltrative and reactive changes had taken place. Their histological aspect was suggestive of phenomena of calcareous degeneration, but microchemical reactions showed that they were due to a precipitation of iron salts on necrotic nerve-cells and on a substance having in the specimens a coagulated appearance. These changes having occurred during the evolution of an inflammatory process, the supposition is made that both the incrustating iron salts and the coagulable material had a hæmatogenous origin and were presumably connected with the presence in the affected brain regions of an exudation possibly containing hæmoglobin. As far as the authors are aware changes of this kind have not as yet been observed in domestic animals under experimental conditions.

C. D. F.

Innervation of Heart Muscle.—J. BOEKE ("The Innervation of the Muscle Fibres of the Myo-Cardium and of the Atrio-Ventricular Bundle of His in the Heart of the Tortoise (emys and cyelemys)," *Proc. Acad. Amsterdam*, 1925, **28**, 32-41, 6 figs.). Working with the tortoise the author claims to have demonstrated conclusively the final innervation of heart muscle. Others had seen the network of delicate fibres surrounding each muscle cell, and one at least (Dogiel) reported

"small knob-like nerve-endings" attached to the surface of fibres. Boeke, however, using the staining method of Bielschowsky, describes branches from the network entering the cell plasm and terminating in "a small end net or end loop or a series of terminal varicosities," often close to the cell nucleus. These delicate threads are beset with varicosities throughout their course and before ending as described may pass through several muscle cells. Similar nerve endings are described in the bundle of His. The author appears to regard the neuro-fibrillary network surrounding the cells and the intra-cellular endings as jointly constituting the mechanism of innervation.

J. F. C. H.

Phagocytic Endothelium in Man.—H. PETERSENS ("Über die Endothelphagocyten des Menschen," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). Free endothelial phagocytes are found in man in the lymph node sinuses and in the blood of the splenic veins, probably also elsewhere. The hæmatology of this cell form, which differs from that of the monocytes can be studied in man without injection of colloidal material. (*Es ist also in der Hamatologie dieser Zellart, die von den Monocyten sicher verschieden ist, Beachtung zu schenken und nach Mitteln zu suchen, sie auch ohne Injektion kolloidaler Stoffe zu studieren, damit man dies auch beim Menschen tun kann.*) They are recognised as especially regular cells of the human body, peculiar to the blood. The following names may be considered for them:—Endothelial phagocytes, endothelial macrophages, erythrophages; the last may be rejected, as it gives no distinction from the "Pulpareticulum," from the others the first is best. As group name only histiocyte can be considered. In connection with the abundant occurrence of connective tissue mast cells in the lymph sinus, these are found everywhere in loose, unformed connective tissue, also in firm and fibrous tissues, sometimes abundantly, sometimes sparsely. Their characteristic motion has hitherto been doubted, but their occurrence in the sinus can only depend on active movement. The mast cell granules are well known to be sensitive to water, and therefore they must be fixed in alcoholic solution before using a water stain such as Giemsa, for instance, though not for too long. Without using characteristic metachromatic stains they elude, as other preparations of the same object show, the certainty of observation.

L. A. H.

Human Heart Muscle.—H. MARCUS ("Über den feineren Bau des menschlichen Herzmuskels. I," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). The myofibril is a tube of $1\ \mu$ diameter, of fluid content with a membrane from whose inner side pass long contractile fibrils. These long tonofibrils anastomose with the transverse system forming a skeleton in the cell, connected peripherally with the sarcolemma and internally with the myofibrils. The sarcolemma is not a membrane but a collection of fibres connected to the perimysium. Cross-striation depends on the formation of droplets in the Z-areas, which go to form the whole of the C-stripes. The Q-stripes of the resting muscle are formed from the sarcosome. All the above structures pass into the bundles of His at the anastomosis of two cells, in order to coordinate the work of the muscle fibres.

L. A. H.

Cells of the Vasa Afferentia of the Kidney of the Mouse.—J. H. C. RUYTER ("Über einen merkwürdigen Abschnitt der Vasa Afferentia in der Mauseniere," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). In the mouse and rat the muscle cells of the tunica media become more or less granular epithelial cells. The vessel walls are thickened and at this region the tunica elastica interna loses its affinity for elastin stains. The modified region stretches for different distances. Sometimes the whole vas afferens is affected, from the arteria interlobularis to the

glomerulus. The change appears after birth, and its significance is not known, but possibly it is to regulate the flow through the glomerulus. As the change appears in the smooth muscle cells they shorten and myofibrils degenerate and disappear. The granules appear probably in the cytoplasm between the fibrils. Such cells are found in the mouse and the rat, but not in man, ape, dog, cat, puppy, or guinea-pig.

L. A. H.

The Movements of Melanophores.—L. C. WYMAN ("Blood and Nerve as Controlling Agents in the Movements of Melanophores," *J. Exp. Zool.*, 1924, **39**, 73–131). Melanophores of the caudal fin of *Fundulus heteroclitus* were examined on the stage of the microscope. Denervation of a part of the tail was accomplished by a median vertical cut which healed in a short time. Complete denervation was checked by histological examination. Melanophores in the denervated region showed immediate and complete expansion, but four or five hours after the operation assumed a semi-contracted condition which was maintained indefinitely. Electrical stimulation of the spinal cord of an operated fish caused complete contraction of the melanophores in all but the denervated region. Direct stimulation of the tail of an operated fish caused complete contraction of the melanophores in both normal and denervated regions. External applications of ether, chloroform, and chloretone to the gills caused expansion of the melanophores everywhere but in a denervated area. Direct application of ether causes expansion of both normal and denervated melanophores. A series of alkaloids was tested by injection into the body cavity and directly on isolated scales. Their action was generally similar. Injection into an operated fish caused melanophore expansion in all parts except the denervated area. Direct application also caused expansion except with santonin and veratrin. Ergot acts through the blood stream, causing contraction of the melanophores followed by partial expansion. Action of salts on the melanophores is direct only. Commercial adrenalin and extract of the posterior lobe of the pituitary act through the blood only, causing melanophore contraction.

A. D. H.

INVERTEBRATE.

General.

Clyde Plankton.—S. M. MARSHALL ("A Survey of Clyde Plankton," *Proc. Roy. Soc. Edin.*, 1925, **45**, 117–41). A detailed account of the plankton month by month in 1923 is given. The general course of events was similar in 1923 and 1924, and is similar to that of other marine biological stations. There is a winter minimum followed in early spring by a large increase in the number of diatoms and larval forms, e.g. copepod, cirripede, molluscan. May and June are poor in diatoms, but rich in crustacean life, notably *Calanus finmarchicus*. In July, August and September diatoms reach their maximum, pendants also, while larvæ and some larger metazoa, such as Medusæ and Chætogonatha are abundant. In the late autumn the number and variety of planktonic organisms decreases.

G. M. F.

Mollusca.

Feeding Mechanism of Pteropods.—C. M. YONGE ("Ciliary Feeding Mechanisms in the Thecosomatous Pteropods," *J. Linn. Soc.*, 1926, **36**, 417–29, 5 figs.). The process of feeding is described and figured in detail for *Cavolinia inflexa*, *Crescis acicula*, *Cymbulia peronii*, and *Gleba (Tiedemannia) cordata*. These

were chosen because, in the order given, they show progressive development of the ciliary mechanisms. Although *Crescis* is considered by systematists to be more primitive than *Cavolinia*, its ciliary arrangements appear more specialized. In all cases the ciliary mechanism is formed by the middle (unpaired) lobe and the two side lobes of the foot; *Gleba* has additional tracts leading to these. In the order in which the species are given there is progressive reduction in area of the ciliary mechanism. In all cases there is an outgoing ciliary tract leading away from the mouth; by this, surplus food material is disposed of. The increased specialization and lessened area of the ciliary mechanism is accompanied by a diminution and final disappearance of the buccal mass, jaws, radula and salivary glands. The course of the food was followed through the alimentary canal of *Crescis*, in which also, by intra vitam staining, the oesophagus, gizzard and digestive gland were found to have pH about 6.0, while for mid-gut and rectum the figure was 7.5-8.0. In all species a ciliated diverticulum opens about the junction of digestive gland and gizzard. Its hyaline secretion is reminiscent of the crystalline style of the Lamellibranchs; it is suggested that this secretion may be associated with the use of vegetable foods and may contain an amylolytic ferment. The observations were made with sea-water suspensions of carmine, Indian ink and fine carborundum.

J. F. C. H.

Nucula.—K. HIRASAKA ("Notes on *Nucula*," *J. Marine Biol. Assn.*, 1927, 14, 629-645, 5 text-figs.). In Protobranchs the palp consists of three different parts—the palp-proboscis, the palp-lamellæ and the palp pouch, the latter found only in *Nucula*. The palp lamellæ correspond to the labial palp of other bivalves, but are far more important and more differentiated than in them. The outer surfaces of both lamellæ are covered with a single layer of cubical or, rather, squamous epithelial cells with inconspicuous short cilia on the outer lamella and devoid of them on the inner lamella, except on its ventral portion. The function of the feeding apparatus is fully discussed. The cephalic sense organ of *Nucula nucleus*, which is innervated directly from the cephalic ganglion, was described by Vlès, 1905. The conclusion is reached that the cephalic organ is not an olfactory organ, but is a visual organ or the remnant of a larval eye.

G. M. F.

Hermaphroditism in the Portuguese Oyster.—I. AMEMIYA ("Hermaphroditism in the Portuguese Oyster," *Proc. Roy. Physical Soc.*, 1925-26, 21, 97-100, 2 text-figs.). The Portuguese oyster, *Ostrea angulata*, belongs to the dioecious group of oysters. The hermaphroditic condition occurs exceptionally in the dioecious form *O. virginica*, but has not been previously recorded in *O. angulata*. Two out of seventy-two examples examined were found to contain both mature sperm and ova.

G. M. F.

Environment and Development of the Eggs of the Japanese Oyster.—H. SENO, J. HORI, D. KUSAKABE ("Effects of Temperature and Salinity on the Development of Eggs of the Common Japanese Oyster *Ostrea gigas* Thunberg," *J. Imp. Fish. Inst.*, 1926, 22, 41-7.) The optimum temperature of the development of the Japanese oyster, *Ostrea gigas* Thunberg, lies between 23°-26° C. The lowest and highest limits of temperature in which the eggs can develop up to the stage of young shelled larvæ are respectively 15° and 30° C. The optimum salinity for development lies between 1.017-1.021 sp. g. at 15°C. The formation of the larval shell is retarded by low temperature or lowered salinity. The percentage of abnormality at various temperatures varies inversely to the percentage of total shelled larvæ produced.

G. M. F.

Mollusca—Gastropoda—The Radula of Proserpina.—H. B. BAKER (*Proc. Acad. Nat. Sci. Philad.*, lxviii, 1926, pp. 449–451). Gray's figure (AMNH (2) vol. 19, p. 184) of the radula of *Ceres salleana* has been assumed to show the close relationship of the Proserpinidæ with the Helicinidæ. Baker has recently examined two specimens of the radula of *Proserpina depressa* (Orb.), which are here described. The central shows no cusps; the first admedian is smaller than the second. There are five admedians, of which the last two are fused. The first four have heavy cutting edges. There are 53 to 55 externals; the first 22 unicuspid, next 3 to 5 bicuspid; while the number is as many as eleven cusps on the outer unci. Baker compares this radula to that of *Calybium monhoti*. He regards "Gray's classic figure" as a confused conception taken from a radula mounted ventral side uppermost; recognizes that it is Helicinid in type; suggests that *Ceres* Gray belongs on this evidence to "a different family from Proserpina," derived from a quite different Helicinid stock, and suspects that *Ceres salleana* Gray was actually an immature Helicina, probably either *H. delicatula* or *H. cinctella*. E. W. B.

Gland-cells of Pteropoda.—G. ROSKIN ("Die Drüsenzelle von Pteropoda," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2, 99–130, 19 text-figs. and 1 pl.). A continuation of Prof. Kolyzoff's work (1911) on the cells of the mantle of *Hyalea tridentata*. These cells are particularly suitable for investigation on account of their large size (c. 135 by 150 μ). The paper includes a detailed account of the discussion of "ergastoplasm" by cytologists. (Cf. WILSON, "The Cell," Ed. 3, p. 724.)

E. W. B.

Nematocysts of Hermæa Bifida.—R. WEILL ("Le Problème des Cleptocnides. Les Nématocystes de *Hermæa bifida* Mont. (Nudibr.)," *Compt. rend. Acad. d. Sc.*, 1926, 183, 154–6). Hitherto the Nudibranchs, known to possess nematocysts, have been distinguished by being carnivorous, especially attacking Coelenterates; by having the ends of their papillæ differentiated as cnidophore sacs; by belonging to the family *Eolididæ*. But *Hermæa* is generally recognized as phytophagous; it possesses no cnidophore sacs; it is not closely related to that family. Yet in two out of five specimens Weill found numerous nematocysts disseminated in the axial hepatic canal and even in the hepatic tissue. They were all of the same type, identical with those found in *Sagartia*. No foreign body was present in the papillæ. This appears to show that *Hermæa* is not exclusively phytophagous. On the other hand there are instances of the accidental occurrence of nematocysts in animals other than Nudibranchs which happen to live in their neighbourhood. He regards the case of *Hermæa* as intermediate between that of the Turbellarians, which have cleptocnides disseminated throughout their epidermis, and that of the *Eolididæ*, in which they occur in localized cnidophore sacs; in *Hermæa*, however, they do not open externally, and therefore it seems impossible to assign any function to them.

E. W. B.

Arthropoda.

Insecta.

A Conopid Fly Carrying the Pollinia of an Orchid.—E. B. POULTON (*Proc. Ent. Soc. London*, 1926, 1, 24–25). A specimen of *Physocephala rufipes* F. (Conopidæ), was found to have six pollinia of an orchid (probably *O. maculata*), attached to the lower part of its face. One of the pollinia was removed for examination by Dr. A. B. Rendle, F.R.S., who made the probable determination of the species of orchid to which the pollina belonged. The fly had been captured at Tubney, near Oxford, on June 24th, 1925.

M. E. M.

Luminous Aquatic Lampyrid Larva.—K. G. BLAIR ("An Aquatic Lampyrid Larva from S. Celebes," *Proc. Ent. Soc. London*, 1926, 1, 18). The larva, which is luminous in life, was collected by Dr. Malcolm Smith at Djikoro, Bothain, S. Celebes, in February, 1925. Luminous points were observed at night on the stones at the bottom of a mountain stream at about 4,000 feet elevation, the water being about 2 feet deep. The larvæ are provided with a long slender sac-like gill on each side of the first eight abdominal segments, while the terminal protrusible group of filaments usual in Lampyrid larvæ is modified to form a clinging organ. The larva belongs to some genus allied to *Luciola*, perhaps to *Pyrophanes*, E. Oliv.
M. E. M.

New Zygæna from Spain.—G. T. BETHUNE-BAKER ("A New Species of Zygæna from Spain," *Proc. Ent. Soc. London*, 1926, 1, II, 19). The species, which has been named *Zygæna chlorinda*, is allied to the *astragali-lonicerae* group, and was at first thought to be *Z. meliloti*, but was subsequently found to be more heavily scaled. It was taken in company with *Z. trifolii*, but that species is much larger than *chlorinda*, and examination of the genitalia of the latter has proved it to be a new species.
M. E. M.

Philippine Carabidæ.—H. E. ANDREWES ("A Catalogue of Philippine Carabidæ," *Philipp. J. Sci.*, 1926, 31, 345-361). In 1886 thirty-three species and varieties of Carabidæ were known from the Philippine Islands. By the early part of 1926 a further 73 had been described or recorded, making 106. To these the author adds a further 49, making a total of 155 species and varieties, which are in alphabetical order with the synonymy. Original references to both genera and species are given, and the Philippine distribution is indicated. The paper concludes with an alphabetically arranged table of specific names and synonyms.
M. E. M.

Fossil Beetles.—M. H. HATCH ("Palæocoleopterology," *Bull. Brooklyn Ent. Soc.*, 1926, 21, 137-144). In an interesting paper the author reviews the knowledge we have acquired in the study of the fossil Coleoptera. With a larval stage capable of occupying a habitat distinct from that of the adult, and with wing-covers enabling them to combine all the advantages of a terrestrial with those of a winged animal, the Coleoptera are among the most successful and dominant groups of non-parasitic terrestrial organisms. In every period since their first appearance in the Trias, beetles constitute an important portion of the known insects; Trias and Lias, 194 species, 25 p.c.; Dogger, Malm, Kreide, 225 species, 35 p.c.; Palæogene, 1,592 species, 37 p.c.; Neogene, 957 species, 37 p.c.; Pleistocene, 715 species, 54 p.c.; Recent, 195,000 species, 41 p.c. The Coleoptera probably have constituted a dominant group of terrestrial animals since the beginning of the Mesozoic era, and there is at present no evidence of decadency in the group as a whole. The general features of coleopterous structure have been retained nearly unaltered since the Trias. Families became established during the Mesozoic, and genera have endured since the commencement of Cenozoic time. Living species came into existence in Pleistocene time. This is practically all that the geological record reveals.
M. E. M.

Lepidoptera from Central Africa.—LOUIS B. PROUT ("Zoological Results of the Swedish Expedition to Central Africa, 1911. Insecta. 20. Lepidoptera. Geometridæ," *Arkiv.för. Zoologi*, 1927, 18, 1-17). The Geometrid material of the expedition embraces 42 species, a few of which are unfortunately not exactly determinable, although mentioned for the sake of completeness. Except for the collecting trip of Mr. T. Alexander Barns in 1919-20, of which some account is

given in Bull. Hill Mus. I (i), pp. 40-44, and of which are published the new Geometridæ (*ibid.*) pp. 138-157, pl. 18), the expedition may be regarded as having opened up virgin soil, so far as concerns the country about Lake Kivu. Six species are here described as new; several others—including a few which will shortly be published in the "Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale"—are known also from Kenya or from Kilimandjaro, etc.; others again are widely distributed African species. Some notes on the geographical distribution of the individual species, so far as this is known, are added to the records. The author has followed as closely as possible the plan of the earlier sections of this work.

M. E. M.

Malformation in Insects.—E. A. COCKAYNE ("Homoeosis and Heteromorphosis in Insects," *Trans. Ent. Soc., London*, 1926, 74, 203-220, 4 pls.). Bateson in 1894 defined homoeosis as a variation, which consists in the assumption by one member of a meristic series of the form and characters proper to other members of the series, and stated that such variations should be recognised as constituting a distinct group of phenomena. Heteromorphoses or heteroplasias are tissues or organs formed before development has been completed, built up of normal cells arranged in an orderly manner, but situated in some anomalous position. The author has collected interesting examples of what may be termed "insect monstrosities." Insects in which eyes are replaced by antennæ, antennæ replaced by legs, metathorax replaced by mesothorax, legs replaced by wings in one instance and by a pencil of hairs in another, one part of a leg replaced by a different part, one part of a wing substituted for another, etc. Tarnani's assertion that the replacement of prothoracic wings by patagia in *Gelechia* was an example of atavism is disputed by Cockayne, who contends that it affords an unsatisfactory explanation of any cases of homoeosis and fails completely to account for those in the Lepidoptera. Gross injury is thought to be the stimulus to the production of some examples of homoeosis, perhaps the majority. But since few injuries have this sequel the particular injuries must alter the conditions during development in a special and unusual way. Data is given which favours this hypothesis, and direct proof is said to be afforded by the experiments of Schmit-Jensen on the Phasmid *Carausius morosus* in which amputation of the antenna was followed by regeneration of the terminal part of a leg with a small but perfect or nearly perfect tarsus. The experiment was repeated and confirmed by Chapman, Cuenot, and Brecker. Details of results of similar experiments on the Crustaceæ are recorded. The work of G. W. Nicholson is mentioned with the following extract from his conclusions: "Our observation seems to indicate that the course of evolution undergone by the cells during their development depends only in part, and that a minor one, on their pedigree. Quite as important, if not more so, are the stimuli that affect them. Position of the body, in relation to the surface and to cells, appears to be the chief of these. When the stimuli are normal, but only so long as they are, the cells of a given part will inevitably assume their stereotyped forms. If they be abnormal, or if the normal stimulus be absent, an abnormality of structure will inevitably result." The author concludes his paper with reference to the suggestion that the normal enervation of the tissues controls the stereotype cell development, with which view he is not in entire agreement.

M. E. M.

Tracheal Respiration in Insects.—M. DU BUISSON ("Observations sur la Ventilation Trathéenne des Insects," *Bull. de la Classe des Sci.*, 5^e Series, 1926, 12, 127-138, 4 text-figs.). The author in the present paper continues his study (begun in two previous publications) of tracheal respiration, and deals with observations

made on *Sirex*, *Dixippus*, and *Embia*. In *Sirex* the mesothoracic stigmata are said to remain closed except during flight. In the primitive type of respiratory action, represented by that of *Stenobothrus*, inspiration takes place via all the stigmata, abdominal and thoracic; and expiration by the thoracic stigmata only. The air-currents are set up by the rhythmical movements of the abdominal segments. In some of the insects studied respiratory movements were found to take place also in the thorax. In others, it is observed that no active respiratory movements occur in any part of the body, and in such cases respiration takes place simply by gaseous diffusion. The author discusses in considerable detail the sequence of the respiratory movements, and the closure and opening of the stigmata which are analysed by means of schematic figures.

M. E. M.

Coleoptera from Oklahoma.—A. I. ORTENBURGER and M. H. HATCH ("Notes on Coleoptera from South-eastern Oklahoma, with a Few Records from the adjacent portions of Texas and Arkansas, including a New Species," *Oklahoma Acad. Sci.*, 1926, 6, 142-148). The senior author was in charge of a collecting expedition in South-eastern Oklahoma sent out by the University of Oklahoma Museum of Zoology. Since the main interest of the expedition was in the vertebrates, comparatively few Coleoptera were secured. The scarcity of published records from this region, however, makes the publication of the present notes worth while. The families represented are *Cicindelidae*, 4 species; *Carabidae*, 24 species; *Omophronidae*, 1 species; *Gyrinidae*, 1 species; *Silphidae*, 1 species; *Histeridae*, 2 species; *Lycidae*, 1 species; *Meloidae*, 2 species; *Elateridae*, 1 species; *Buprestidae*, 1 species; *Dermestidae*, 1 species; *Tenebrionidae*, 3 species; *Scarabaeidae*, 18 species, including the new species, *Polyphylla oklahomensis*, Hatch; *Lucanidae*, 1 species; *Passalidae*, 1 species; *Cerambycidae*, 7 species; *Chrysomelidae*, 2 species.

M. E. M.

British Spiders.—T. H. SAVORY ("British Spiders of the Genus *Leptyphantes*," *J. Quekett Micr. Club*, 1927, 15, 243-254, 5 text-figs.). The genus *Leptyphantes* is not only one of the largest of the genera of British spiders, it is also one of the most difficult to separate, and is the cause of most bewilderment to collectors. The author has attempted to reduce the difficulties of identification by bringing together the scattered information and older descriptions to which have been added the necessary comparative data. The generic characters are described, and a list of 20 British species and their synonyma are dealt with. These species are divided into two groups:—"A," with more than one metatarsal spine; and "B," with only one metatarsal spine. The characters by which the species are distinguished are described in the text and also by means of figures showing the specific characters of the *epigynes*, *palpi* and *paracymbia*. The author briefly records the known distribution of the British *Leptyphantes*. The paper concludes with an account of technical methods for microscopically mounting the external organs which show the specific characters, and the technique required for the general examination of spiders, advocating the use of granulated tin, in place of the more commonly used cotton-wool, on which to rest the specimen under examination.

M. E. M.

Philippine Carabidae.—H. E. ANDREWS ("A Catalogue of Philippine Carabidae," *Philipp. J. Sci.*, 1926, 31, 345-361). In 1886 thirty-three species and varieties of *Carabidae* were known from the Philippine Islands. By the early part of 1926 a further seventy-three had been described or recorded, making one hundred and six. To these the author adds an additional forty-nine, making a

total of one hundred and fifty-five species and varieties which are tabulated in alphabetical order with the synonyma. Original references to both genera and species are given, and the Philippine distribution is indicated. M. E. M.

Ultra-Violet Rays and *Drosophila*.—R. GEIGY ("Une anomalie non-héréditaire provoquée par les rayons ultra-violetes chez la drosophile," *Compt. Rend. de la Soc. Phys. et d'Hist. Nat. de Genève*, 1926, 43, 143-145). The eggs, larvæ at all instars, and pupæ of various ages of a "wild" strain of *Drosophila* were exposed for various periods to ultra-violet rays generated by a "Hohensonne" lamp, the insects being placed at a distance of 60 cm. from the lamp, and the radiation striking the dorsal surface. With larvæ almost ready to pupate it was found that an exposure of from 10-13 minutes rapidly killed the larvæ or prevented their metamorphosis. An 8 minutes exposure of 50 larvæ caused only 5 to complete their metamorphosis. The latter showed striking abnormalities on the dorsal surface, such as depigmentation, indistinct, and weakly chitinised abdominal segments. The flies rapidly died without exhibiting reproductive activities. Three minutes exposure to the rays was found to have no adverse influence upon tissue development, but some effect was noticed upon the vitality. Very young pupæ were found to tolerate up to 13 minutes exposure. After 13 minutes exposure in pupæ showing the developing imagines it was regularly found (90 p.c. of the cases) that an abnormality of the abdomen occurred. The following associated abnormalities were also frequently exhibited:—(a) Reduction in size or partial absence of the characteristic hairs of the head and thorax; (b) complete disarrangement of the normal disposition of the hairs on the thorax; (c) deformation of the thorax, causing it to become more convex than usual; (d) irregular or incomplete pigmentation on the dorsal surface of the body; (e) torsion of the genito-anal region. Pupæ containing fully developed imagines were found to withstand an exposure of from 20-30 minutes, at a reduced distance (40 cm.) from the lamp without the production of any discernible abnormality in the abdomen. Such insects were found to be normally reproductive. The author concludes from his experiments and observations that the abnormalities produced by exposure to the ultra-violet rays are not hereditary. M. E. M.

Water Mites from Cuba.—R. MARSHALL ("Water Mites from Cuba," *Trans. Amer. Micr. Soc.*, 1927, 46, 60-5, 2 pls.). A detailed description of three new species of hydrachnids from Cuba is given. These are *Arrheniuses hababacus* Mar., *Piona mariancensis* Mar. and *Xystonotus torrei* Mar. *Arrheniuses hababacus* Mar. is characterised by the palpi having a large tuft of long heavy bristles which are blunt and curved; these are found on the second joint. G. M. F.

Insect Metamorphosis and Thyroid Feeding.—S. KOPEĆ ("Is the Insect Metamorphosis influenced by Thyroid Feeding?" *Biol. Bull.*, 1926, 50, 339-354). The administration of thyroid to caterpillars of *Lymantria dispar* L. and of Lugol's solution (KI + I) to the caterpillars of *Pieris brassicæ* L. caused no change in the duration of the larval or pupal period. The only effect was a distinct diminution of the weight of the chrysalids. G. M. G.

Arthropoda.

Crustacea.

Motor Nerve Endings in Somatic Muscles of Decapoda.—U. D'ANCONA ("Delle terminazioni nervose nei muscoli somatici dei crostacei decapodi," *Atti. d. r. Accad. Lincei*, 1925, 1 (VIS), 403-5). Preliminary investigations

carried out by one of Cajal's reduced silver methods show that in *Macrura* (*Astacus fluviatilis*, *Homarus vulgaris*, *Palinurus vulgaris*) the motor nerve endings consist of simple arborisations with pointed ends, while in *Brachyura* (*Carcinus maenas*) motor plates surrounded by a granular plasma (sole) are found. These plates are similar to those of vertebrates and frequently have a hypolemmal situation. In *Astacus* and *Homarus* the simple nerve ending is sometimes formed of two fibres arising from two different nerve-trunks, a condition which reminds one of the accessory and supposedly sympathetic fibres (Perroncito, Boeke) occasionally observed in striped muscles of vertebrates.

C. D. F.

A Freshwater Ostracod.—O. F. MULLER ("On the Feeding Mechanism of a Freshwater Ostracod, *Pionocypris vidua*," *Jour. Linn. Soc. Zool. (London)*, 1926, 36, 325–335, 1 pl., 5 figs.). The shell-cavity of *Pionocypris vidua* is incompletely divided into two chambers by the "oral mass," consisting of the labrum and hypostome suspended from the dorsal parts of the valves. The mouth entrance is level with the ventral edges of the shell. An antero-posterior stream passing through the shell is produced by three vibratory plates, the most important of which occurs on the maxillule and oscillates in the posterior shell chamber. *P. vidua* is a crawling form feeding on particles disturbed in its wanderings. Particles are sucked in by the water stream caught on the mandibular palps and passed back on to the maxillules. They here become entangled in a viscid secretion presumably from the labral glands, and deposited at the entrance to the mouth. This mass is then transferred on to the mandibles, and so into the oesophagus by a pair of "food rakes" on the posterior wall of the oral cavity.

H. G. C.

Development of the Fairy Shrimp.—H. G. CANNON ("On the Post-Embryonic Development of the Fairy Shrimp, *Chirocephalus diaphanus*," *Jour. Linn. Soc.-Zool. (London)*, 1926, 36, 401–416, 2 pl., 3 figs.). The development of *Chirocephalus diaphanus* is essentially similar to that of *Estheria*. Coelomic sacs are formed, but do not attain any considerable size owing to the precocious development of the pericardial cavity. The development of the maxillary gland shows no essential difference from that of *Estheria*. The antennal gland possesses, between end sac and duct, a sphincter of three cells connected directly to the cuticle. The musculature is more complex than that of *Estheria*, there being a series of "connective muscles" between the dorsal and ventral longitudinal muscles. The dorso-ventral muscles, the proctodæal dilators, and probably the stomodæal dilators are of ectodermal origin.

H. G. C.

Larval Stages of Crabs.—M. V. LEBOUR ("Studies of the Plymouth *Brachyura*. I. The Rearing of Crabs in Captivity, with a description of the larval stages of *Inachus Dorsettensis*, *Macropodia longivostris* and *Maia squinado*," *J. Marine Biol. Assn.*, 1927, 14, 759–821, 4 pl.). The larvæ of the three crabs representing three distinct genera and two distinct sub-families are compared. In *Maia* there are the usual seven abdominal segments in the second zœa, megalopa and crab while there are only six in *Inachus* and *Macropodia* and in consequence there are five pairs of pleopods in *Maia* and only four in *Inachus* and *Macropodia*. The carapace differs in there being dorsal, rostral and lateral spines in the zœa of *Maia* and only a dorsal spine in *Inachus* and *Macropodia*, and the telson differs in having three lateral spines in *Maia* and only one in *Inachus* and *Macropodia*. The antenna differs in the exopodite of *Maia*, being hardly more than half the length of the spinous process and ending in three spines; while in *Inachus* and

Macropodia the exopodite is pointed and almost equal in length to the spinous process. In the megalopa the differences are also large. In *Maia* there are no spines on the carapace only rounded prominences, and the last joints of the second to the fifth walking legs bear short spines, whereas in *Inachus* and *Macropodia* there are distinct spines on the carapace, and the last joints of the legs are long and pointed and the tips only armed with minute spicules. G. M. F.

Spermatogenesis in Crab.—N. FASTEN ("Spermatogenesis of the Black, Clawed Crab," *Lophopanopeus bellus* (Stimpson) Rathbun, *Biol. Bull.*, 1926, **50**, 277–293, 3 pls.). During the latter part of June and early portion of July the testis of *Lophopanopeus bellus* (Stimpson) Rathbun is in the best condition for the study of spermatogenesis. Primary and secondary spermatogonial divisions can be distinguished. The spermatogonial chromosomes are univalent and probably number around 124. Large nutritive cells are frequently associated with spermatogonial strips in tubules where there are mature spermatozoa. These have irregular nuclei and are produced from primary spermatogonia which failed to mature. The primary spermatocyte undergoes growth parasynapsis, tetrad-formation and reduction division. There are 62 bivalent chromosomes seen in polar views of the metaphase stages of this division. During the growth period a chromatoid body appears in the cytoplasm, and, when the reduction division takes place, this wanders undivided to one of the poles of the cell, resulting in the formation of two kinds of secondary spermatocytes, one of which possesses the structure and the other which is devoid of it. There is no rest period between the primary and secondary spermatocytes. The division of the latter is equational and produces two types of spermatids, one having a chromatoid body and the other which is minus such a structure. This last type is about three times as numerous as the former one. At an early stage the chromatoid body is expelled from the spermatids which contain it, and from then on all the spermatids undergo similar complicated transformations. These changes bring about the formation of the radial spermatozoa which are packed away in single spermatophores with the vas deferens ducts. Four kinds of mature spermatozoa may be distinguished, namely three, four, five and six rayed types. The four and five-rayed spermatozoa are the ones which are encountered most frequently. G. M. F.

A Mysid Crustacean.—CANNON, H. GRAHAM and Miss S. M. MANTON, "The Feeding Mechanism of a Mysid Crustacean, *Hemimysis Lamornæ*," *Phil. Trans. R. Soc., Edinburgh*, 1927, **55**, 219–253, 4 pl., 10 figs.). *H. Lamornæ* exhibits two types of feeding, one on a large food masses and the other on minute particles filtered from a water current. In the filter mechanism the maxilla acts as a suction pump and a true filter. The comb of setæ on the proximal endite forms the filter plate. The filtered food is pushed on the mouth between the bases of the paragnaths by the long setæ of the maxillary proximal endites and the comb of setæ on the proximal endites of the first trunk limbs. It is pushed directly on to the spinous rows of the mandibles. The food stream along the ventral food groove is produced by the swimming activities of the trunk limbs. Each exopodite rotates so that its tip describes an ellipse. By this rotatory action a food-bearing stream is sucked down each cone of rotation and passes in between the limb bases to the ventral food groove. Large food masses are held by the trunk limb endopodites and mandibular palps and bitten into by the incisor processes of the mandibles and the distal endites of the maxillules. The mandibles are asymmetrically arranged so that food bitten off by the incisor processes is automatically passed on to the *lacinie mobiles* and then to the molar processes. Storch's description of the

feeding process of a Daphnid and his views on the evolution of the feeding mechanism of the Crustacea and Trilobites are criticised. Simple biramous swimming paddle limbs, such as occur posteriorly in *Lepidocaris*, are suggested as being the primitive limb rather than the filtering "phyllopodium" as considered by Storch. From primitive articulates possessing biramous limbs there evolved on the one hand, the Branchiopoda, and the other Crustacea, in which the limbs projected ventrally from the body in two parallel series, and on the other, Marella and the Trilobites, in which the limbs projected laterally. In the Branchiopoda the endopodite became a foliaceous swimming organ, while in the Malacostraca the exopodite became the swimming part, but it became whiplike and not foliaceous. In both cases the swimming activities produced an orally directed food stream. In Marella and the Trilobites the foliaceous exopodite became the swimming branch of the limb. In the Trilobites the pleural shield developed to enhance the food collecting activities of the exopodites. In both Trilobites and Crustacea the presence of a large labrum assists in sucking food into the mouth region.

H. G. C.

Oligochaeta.

Lumbricillus Scoticus, n. sp.—R. ELMHIRST and J. STEPHENSON ("On *Lumbricillus scoticus*, n. sp.," *J. Marine Biol. Assn.*, 1926, 14, 469-73, 3 text-figs.). A small orange-coloured Enchytracid Oligochaete has been known for some years to occur fairly abundantly in certain sheltered parts of the shores on the Cumbraes. It is also generally present, though scarce, on exposed parts of the shore. It has previously been confounded with other species of *Lumbricillus*, but is now described as a new species. It resembles *L. minutus* (Mill), in the large number of setae per bundle, and in its short and stout habit. It differs, however, in the fact that the nephridial ducts come off from the hinder end, not from the middle of the post-septal portion and in having a single mass of gland cells round the spermathecal duct, while *L. minutus* is said to have two series of glands in relation to the duct.

G. M. F.

Platyhelminthes.

Trematoda.

A New Trematode Proalaria Huronensis.—G. R. LA RUE ("Studies on the Trematode Family Strigeidae (Holostomidae), V. *Proalaria huronensis*, sp. nov.," *Trans. Amer. Micr. Soc.*, 1927, 46, 26-35, 2 pls.). An apparently new trematode species, belonging to the family Strigeidae, for which the name *Proalaria huronensis* is proposed. It occurs in considerable abundance in young herring gulls *Larus argentatus* Pont., taken in the region of Lake Huron. The anatomical features are described. It most closely resembles *Proalaria spathaceum* (Rad.), but is smaller while the fore-body is relatively broader and the hind-body relatively shorter.

G. M. F.

Studies on the Trematode Family Strigeidae Holostomidae.—G. R. LA RUE (No. III "Relationships," *Trans. Amer. Micr. Soc.*, 1926, 45, 265-81, 1 pl.); G. R. LA RUE, E. P. BUTLER and P. G. BERKHOUT (No. IV, "The Eyes of Fishes, and Important Habitat for Larval Strigeidae," *Trans. Amer. Micr. Soc.*, 1926, 45, 282-8). As a basis for determining relationships among digenetic trematodes the comparative anatomy of the generative organs of the adults (maritæ) is largely relied upon, but the excretory system of the cercariae also gives valuable data. The life history of Strigeidae and the homologies of their organs to those of other Trematodes is discussed, a full classification of the order Strigeatoidea being given.

Metacercariæ of Strigeidæ have been found parasitic in the eyes of a large number of fish such as the sturgeon, *Acipenser nabicundus* Le Sueur, and the lake herring, *Leucichthys artedi* Le Sueur, obtained from Lake Michigan. Out of 349 fish examined, 245 had eyes infected with metacercariæ. These parasites are therefore not restricted to the fish of small lakes or streams.

G. M. F.

Gastrotricha.

The Classification of the Gastrotricha, Aberrant and Normal.—A. REMANE ("Morphologie und Verwandtschaftsbeziehungen der aberranten Gastrotrichen, I," *Zeits. Morph. Ökol. Tiere*, 1926, 5, 625-754, 82 text-figs.). The author gives fuller morphological particulars of the recently described species, *Macrodasys buddenbrocki* Remane and *Turbanella cornuta* Remane. He creates seven new genera, Dactylopodella, Thaumastoderma, Tetranchyroderma, Ptychos-tomella, Cephalodasys, Lepidodasys and Urodasys, each represented by a single new species, which is described in full detail. All these forms have been found in clean sands dredged from various stations in the vicinity of Kiel, but *M. buddenbrocki* has also been found, and more abundantly, in rotted sea-grass. In most cases the stomachs contained ingested diatoms. A distinctive and common feature of these animals is the possession of minute tubules, few or numerous, distributed with some regularity over the lateral areas of the body, and in groups on the ventral surface of or near the head, and at the rear of the tail, each tubule having a minute mucus-gland. These tubules increase in number during the growth of the animal. By their means the creatures, whose normal motion is a gentle gliding over the sand, effected by their ventral cilia, can affix themselves when alarmed, or can march about after the fashion of a looper caterpillar. In *Turbanella* this unexpected movement was seen to take place both backwards and forwards. In that genus, moreover, the lateral tubules are provided with a long, active cilium. In *Urodasys* the body ends in a slender tail, one and a half times the length of the normal body, and this tail is itself provided with some fifty of these tubules, arranged asymmetrically, to right and left alternately, along its sides, the whole animal studied, while apparently immature, having a length of 1.5 mm.

On the data obtained from these exhaustive studies of the new forms and from other available material, Remane considers that the normal Gastrotricha are the nearest in relationship to the aberrant Gastrotricha, and he places both groups in the class *Gastrotricha*, with a much extended definition, as a section of the Aschelminthes, dividing the class into two orders, the *Macrodasyoidea* and the *Chaetono-toidea*, to include the aberrant and the normal Gastrotricha respectively as proposed in his paper of the previous year, for which orders he now formulates definitions.

The relationship of the Gastrotricha, as now defined, to the Nematodes, the Kynorhyncha, the Annelids and to the Rotatoria are discussed seriatim and comprehensively. Dissenting from the dictum of Zelinka, followed by most recent authors, that the Rotatoria are nearest in relationship to the Gastrotricha, and without denying that there is relationship between these two classes, he declares that the nearest relations of the Gastrotricha are the Nematodes and the Archannelides, between which the Gastrotricha occupy an intermediate position. The Rotatoria, not quite so closely related to the Gastrotricha, stand apart, but form likewise a section of the Aschelminthes.

D. B.

The Affinities of the Aberrant Gastrotricha.—A. REMANE ("Organisation und Systematische Stellung der aberranten Gastrotrichen," *Verh. Deutsch.*

Zool. Ges., 1925, **30**, 121-8). On the basis of the data afforded by the examination of recently-discovered new species (representing eight new genera), the author summarizes the leading characteristics of the aberrant Gastrotricha, a group hitherto almost unknown, which he considers to be a systematic unity, and, notwithstanding many differences, to be nearest to the normal Gastrotricha in relationship. He therefore proposes to unite the two groups as the Gastrotricha, the normal forms to be placed in the Order Chætonotoidea and the aberrant to be assigned to the Order Macrodasypoidea. The group of the Gastrotricha is thus considerably enlarged, and the gaps between it and the Nematodes on the one hand, and between it and the Archiannelides on the other hand, are found to be appreciably lessened. D. B.

Coelenterata.

The Cnidome of Trachylinæ.—R. WEILL ("Le Cnidome des Trachylides, Trachyméduses et Narcoméduses," *Compt. rend. Acad. d. Sc.*, 1926, **182**, 1357-9, 1 text-fig.). Four coelenterates, of the order Trachylinæ are described as having a mononidome, i.e. all the nematocysts present in each are of a single type. In the Trachymedusæ, *Camarina hastata* Hæckel has bilaterally symmetrical nematocysts in which the axial body is attached to the opercular pole by a "prestylar bladder," a thin twisted prolongation of the central bladder. When devaginated the tube has a long basal bladder, surrounded by spikes set in three right handed spirals, which are continued down the tube as three ridges. The nematocysts on the manubrium are slightly smaller than those described, but otherwise identical. In *Liriope eurybia* the nematocysts are also all similar except in size, and differ from those of *C. hastata* only in absence of prestylar bladder, and inferior dimensions (916 by 8 μ). In the Narcomedusæ a very primitive mononidome occurs in *Cunina lativentris* Geg. The nematocysts are subspherical and 4-12 μ in diameter; the filament is isodiametrical, and surrounded by three ridges in a right-handed spiral. Certain Narcomedusa larvæ examined also had a mononidome identical with that of *C. lativentris*. Of forty-four species of other groups studied, not one had a mononidome; the author inclines to the view that the Trachylinæ are the primitive coelenterates which stand nearest to the common origin of the Hydromedusæ and Scyphomedusæ. S. D. K.

Protoplasmic Papillæ of Echinarachnius Oocytes.—W. SEIFRIZ (*Protoplasma*, 1926, **1**, 1-14, 7 text-figs., 3 pls.). Unripe eggs of *Echinarachnius parma*, with germinal vesicles intact, in the presence of sperm, give rise to protoplasmic processes protruding from the surface of the oocyte. These processes are termed by the author, oocyte papillæ. They may be fine threads, heavy club-shaped structures, or thin, broad films. They are from exuded hyaline protoplasm, amœboid in movement and of temporary existence, persisting about 20 minutes. They are apparently functionless structures representing a premature response which, in the ripe ovum, or in the embryo, would produce similar but functional processes. The papillæ are endowed with marked rigidity, elasticity and tensile strength. A good sized papilla may be bent by means of a microneedle until it lies on the surface of the egg; yet on removal of the needle, the papilla quickly comes to its original upright position. There is nothing in the nature of a liquid, or of a dilute soft, or plastic substance about the protoplasm of which the papillæ are made. If a micro-needle is placed within the exuded protoplasm and is then drawn away from the egg with the papilla, the needle does not pass through the protoplasm nor is the papilla torn off, as it would if it were liquid or soft, but the protoplasm of the papilla holds firm and withstands a pull sufficient to distort the entire egg. This behaviour is

another instance of many which have led the author to emphasize the gel nature of protoplasm and to conclude that the living substance is a hydrophilic colloidal jelly.

C. D. F.

Protozoa.

Hoplonympha, gen. n.—S. F. LIGHT ("On *Hoplonympha natator* gen. nov., sp. nov.; a non-xylophagous hypermastigote from the termite, *Kaloterms simplicicornis* Banks, characterized by biradial symmetry and a highly developed pellicle," *Univ. Calif. Publ. Zoo.*, 1926, 29, 123-139, 28 text-figs.). For this flagellate a new genus, *Hoplonympha*, and family Hoplonymphidae (Hypermastigina) are proposed. *H. natator* n. sp. occurs in the hind-gut of the termite *Kaloterms simplicicornis*. It has an elongated body measuring on an average 90 by 9 μ , and is bilaterally symmetrical. There are two lateral bundles of flagella, each arising from a special plate near the anterior end of the body, which is covered by a pellicular armour. At the anterior pole of the body there is a vesicle ("cap") containing chromatic elements (blepharoplast?), from which the flagellar plates and the rhizoplast bands running to the nucleus arise. The nucleus, which is at the anterior end of the body, is suspended by a column of specialised granular cytoplasm. The neuromotor structures are distributed equally during mitosis.

C. A. H.

Metadevescovina, gen. n.—S. F. LIGHT ("On *Metadevescovina debilis* gen. nov., sp. nov.: a xylophagous polymastigote from the termite, *Kaloterms hubbardi*, Banks," *Univ. Calif. Publ. Zoo.*, 1926, 29, 147-157, 1 pl., 3 text-figs.). *Metadevescovina debilis* n.g., n. sp., is found in the intestine of the termite *Kaloterms hubbardi*. Its body is elongated oval, averaging 45 by 20 μ in size. There are three anterior flagella, and one long trailing flagellum. An intracytoplasmic fibril associated with the bases of the anterior flagella gives rise to a number of short flagella. At the base of the trailing flagellum lies a short, curved chromatic basal rod. The nucleus is in the anterior end and is connected by a neck with the neuromotor centre. The axostyle extends throughout the body and is associated with the neuromotor apparatus anteriorly. The large parabasal body winds spirally about the nucleus and axostyle. The characters of the new genus are intermediate between those of the Polymastigina and the Hypermastigina.

C. A. H.

Staurojoenina.—H. KIRBY ("On *Staurojoenina assimilis* sp. nov., an intestinal flagellate from the termite, *Kaloterms minor* Hagen," *Univ. Calif. Publ. Zoo.*, 1926, 29, 25-102, 7 pls., 7 text-figs.). *Staurojoenina assimilis* n. sp. (o. Hypermastigina, fam. Staurojoeninidae) occurs in the intestine of the termite, *Kaloterms minor*, from California and Arizona. The length of this flagellate varies from 105 to 190 μ , averaging 142 μ . The distance from the anterior end of the neuromotor structures to the posterior end of the nucleus is fairly constant (65-70 μ). The neuromotor system is of complex structure. The flagella, of which there are several hundred, are disposed in four bands, occupying the sides of the coniform anterior end. They are attached in special grooves to four plates, in which the basal granules are embedded. Each of the plates is composed of about nine bands, connected anteriorly to the quadripartite "centroblepharoplast" (Grassi's radial bands). The last-named structure is connected posteriorly with the nucleus. Between the plates there are four protoplasmic lobes, supported by four series of filaments with a comb-like arrangement ("ctenofilaments"). These filaments continue posteriorly beyond the nucleus, where they unite into four stout filaments, terminating in the posterior end of the body. The nucleus divides mitotically,

giving rise to 24 chromosomes. A complete systematic review of the Protozoa found in termites is given and a comparative study is made of the structure and nuclear division of these flagellates.

C. A. H.

Trichomonas buccalis.—H. C. HENSHAW ("On the Morphology and Mitosis of *Trichomonas buccalis* (Goodey) Kofoid," *Univ. Calif. Publ. Zoo.*, 1926, **29**, 159–174, 1 pl., 2 text-figs.). The neuromotor apparatus of *T. buccalis* is as follows:—At the anterior end of the body there are three blepharoplasts. The central one gives rise to the two central flagella, the "ventral" gives off the ventral flagellum, undulating membrane and chromatic basal rod, while the "dorsal" gives rise to the dorsal flagellum and axostyle. The central blepharoplast is also connected with the nucleus by a rhizoplast which terminates in a siderophile granule (centrosome) lying on the nuclear membrane. The nucleus contains six or more chromatin granules staining deeply with iron hæmatoxylin. During division, which is mitotic, the chromatin becomes differentiated into three structurally different chromosomes. The flagella are evenly divided between the daughter individuals, the full complement being restored by outgrowth from the blepharoplasts. The old axostyle degenerates, the daughter ones being produced from the blepharoplasts.

C. A. H.

Excystment in "Councilmania lafleuri."—E. A. ALLEN ("Excystment of *Councilmania lafleuri* Kofoid and Swezy in culture in vitro," *Univ. Calif. Publ. Zoo.*, 1926, **29**, 175–178, 28 text-figs.). The author records observations on the process of excystation in the human intestinal amoeba *Councilmania lafleuri* [*Entamoeba coli*, according to some authorities]. The cysts of the amoebæ were kept in culture (Ringer's solution to which 0.01 p.c. dextrine was added). Uninuclear "amebulæ" were found free and in the act of escaping from the cyst through a special pore. It is stated that, since the encysted amoeba usually contains 8 nuclei, "the other seven had presumably already escaped in amebulæ budded off from the original protoplasm."

C. A. H.

Ptyssostoma, gen. n.—C. C. HENTSCHEL ("On a new ciliate, *Ptyssostoma thalassema* nov. gen., nov. sp., from the intestine of the echiuroid worm, *Thalassema neptuni* Gärtner," *J. Mar. Biol. Assoc.*, N.S., 1927, **14**, 651–656, 3 text-figs.). *Ptyssostoma thalassema* n. gen., n. sp., a holotrichous gymnostomatous ciliate is parasitic in the intestine of the Echiuroid worm, *Thalassema neptuni* Plymouth. The mouth, peculiar to this form, is situated near the anterior end and consists of a kidney-shaped, folded apparatus, supported by a horsehair-shaped skeletal loop. There is also a narrow conical gullet. The cilia are arranged in about 35 rows. The anterior end of the body forms a mobile prominence. The nuclei are in the middle of the body. Size 75–100 μ = 55–75 μ .

C. A. H.

Flagellates of Cryptotermes.—H. KIRBY ("The Intestinal Flagellates of the Termite, *Cryptotermes hermsi* Kirby," *Univ. Calif. Publ. Zoo.*, 1926, **29**, 103–120, 2 pls., 4 text-figs.). Ten species of flagellates belonging to the families Tetramitidæ and Calonymphidæ (Polymastigina) are described from the termite *Cryptotermes hermsi*. Four of these flagellates are new and are characterised as follows:—(1) *Devescovina lemniscata* n. sp.: size 28 by 11 μ , body oval or pyriform, with axostyle projecting. The rostrum forms a whip of three flagella. The neuromotor apparatus comprises these flagella, a band-like trailing flagellum, a blepharoplast, rhizoplast, centrosome, parabasal, chromatic basal rod and axostyle. (2) *Stephanonympha nelumbium* n. sp.: size 45 by 27 μ . Nuclei spirally arranged

in 4-7 series, parabasals small, spherical, with parabasal thread along lower edge. Blepharoplasts large, surmounted by a conical structure from which four flagella arise. (3) *Paradevescovina nana* n. g., n. sp.: small flagellates (10 by 7 μ) with structures similar to those of *Devescovina*, but differing from this genus in that the parabasal body, running at first close to the nucleus, turns to the periphery and continues as a slender rod. The axosytle is stout, curved or sygmoid. (4) *Oxymonas parvula* n. sp.: body flask-like or ovoid, measuring 5-13 μ in length. C. A. H.

Amœbiasis in Rabbit.—M. D. THOMSON ("Experimental Amœbiasis in the Rabbit," *Univ. Calif. Publ. Zoo.*, 29, 9-23, 5 text-figs.). Three rabbits were fed on cysts of *Entamœba dysenteriae* [= *Entamœba histolytica*]. Infection took place in one of the animals and was located in the cæcum, sections of which showed an amœbic invasion of the mucosa, submucosa and the circular muscular layer. Lymph nodes and channels were also infected and amœbæ were found in the lumen of the blood-vessels. The histological picture described is illustrated by five photomicrographs. C. A. H.

Foraminiferal Research.—J. A. CUSHMAN (*Contrib. Cushman Lab. Foramin. Res.*, 1927, 2, Pt. 4, Nos. 33-37, 3 pls.). Five short papers. In the first Cushman proposes names for ten new genera to accommodate species at present included with others from which closer study has shown them to differ in development and phylogenetic relationships. In No. 34, Cushman and Waters collaborate in describing 9 species of arenaceous foraminifera from the Upper Cretaceous of Texas; 7 of these are described as new species. In certain zones, especially in the Navarro formation, few other forms than the arenaceous are found. In No. 35, Cushman compares Upper Cretaceous species from Europe and America; in No. 36 the same author with Harris gives some measurements of *Pulvinulina menardii* from different localities and of other foraminifera, and the suggestion is made "that with a long-lived species or series of related species, it may be possible by the simple method of measuring a series of adult specimens to place the sample containing them in its relative position in the geologic column." In No. 37, Cushman describes, from material of the late Dr. Flint, a specimen for which he erects a new genus *sporadogenerina*; he considers the genus degenerate and bestows on the gen type the specific name *flintii*. J. F. C. H.

Classification of Foraminifera.—J. A. CUSHMAN ("An Outline of a Reclassification of the Foraminifera," *Contrib. Cushman Lab. Foramin. Res.*, 1927, 3, Pt. 1, No. 39, 16 pls.). In the course of teaching, the author has found it necessary to collate the publications of the past twenty years in order that a more natural grouping of the foraminifera might be presented. He has incorporated the notes made in course of his own researches, and publishes in outline a reclassification following in general H. Douvillé. J. F. C. H.

Tertiary Foraminifera of Australia.—F. CHAPMAN and W. J. PARR (*J. Linn. Soc.*, 1926, 36, 373-399, 5 pls., numerous refs.). This is Part II. of a description of the Balcombian foraminifera of Port Phillip, the first instalment having been published by F. Chapman in 1907 in the same journal. This article deals with the Lagenidæ and eighty-six species and varieties are described, of which one species and one variety are new and many are forms not previously recorded from this area. The new species is given the name *Cristellaria paucicostulata* and falls into the "planulate" group typified by *C. gemmata* Brady and *C. bradyana* Chapman. It is described thus: "Test compressed, ovate, thin, . . . whorls evolute . . . outer whorl consisting of six chambers, . . . surface of each segment

flat or irregularly inflated except the last which is moderately and evenly inflated. Sutures slightly curved in early portion of shell, the last three more strongly recurved exteriorly. Edge of test carinate. Apertural extremity prolonged into a short spout-like form. Length 0.76 mm.; width 0.52 mm." It was found in Kackeraboite Creek and is very rare. The new variety is *Uvigerina pygmaea* d'Orb. var. *Macilenta*, nov. and differs from type in "the absence of the strongly costate surface." It occurs frequently in Grice's Creek. J. F. C. H.

Tertiary Foraminifera of Victoria.—F. CHAPMAN and W. J. PARR ("Tertiary Foraminifera of Victoria, Australia.—The Balcombian Deposits of Port Phillip. Part II.", *J. Linn. Soc. (Zool.)*, 1926, **36**, 373–99, 5 pls.). The enormous amount of time and labour involved in the examination of the micro-fauna of fossil deposits can only be appreciated by those who have undertaken the work, and is doubtless responsible for the delay in the publication of this second part of a long expected paper. It is just 20 years since Chapman published the first part dealing with the families Nilistidae, Astroshizidae and Textulariidae and workers in all parts of the world had almost abandoned the hope of its completion. Part II deals with the family Lagenidae only and contains records of 86 species and varieties with much valuable information as to their distribution in Australia and elsewhere. Many of the species have not been recorded previously from the Australian area, either in the recent or fossil condition. The fact that only one species and one variety are described as new to science may be regarded as evidence of the conservative manner in which the authors have dealt with their material. The permanent character of the Australian shizopodal fauna has been noted by many observers. Further evidence of its antiquity and stability will be found in this paper, which records many species which are still existing in adjacent seas, some of them being unrecorded elsewhere. The paper is liberally illustrated, there being a separate drawing for each species recorded.

Spores of Porospora (Nematopsis).—P. HATT ("Spores de Porospora (Nematopsis) chez les Gastéropodes," *C. r. Soc. de Biol.*, 1927, **96**, 90–91). Originally discovered by Schneider in the mantle of *Solen* the spores of *Porospora* have up to the present only been described in mussels and other lamellibranchs. They are now recorded in *Trochocochlea turbinata* Born., *T. articulata* Lam., *T. mutabilis* Philippi, *Phorus richardi* Payraudeau, *Gibbula divaricata* Linne, *G. varilineata* Michaud, *Pisania maculosa* Lam. and *Cerithium rupestro* Risso. G. M. F.

Mitotic Division of *Trichonympha chattoni*.—O. DUBOSQ and P. GRASSÉ ("Sur la division mitotique de *Trichonympha chattoni*, Dub. et Grassé," *C. r. Soc. de Biol.*, 1927, **96**, 92–94, 1 text-fig.). *Trichonympha chattoni*, a parasite of an Australian termite. *Glyptotermes iridipennis* Frogg is characterised by the relative smallness of the area from which flagella spring and also by its para-basal layer. There are fourteen or perhaps sixteen chromosomes of a dense chromatin.

G. M. F.

***Zelleriella piscicola*, n. sp.**—A. M. DA CUNHA and J. C. N. PENIDO ("Nouveau protozaire parasite des poissons, *Zelleriella piscicola*, n. sp.," *C. r. Soc. de Biol.*, 1926, **95**, 1003–5, 6 text-figs.). *Z. piscicola*, n. sp., is flat and oval, measuring 70–110 μ by 50–65 μ . The cilia are longest and most numerous anteriorly. The ectoplasm under the pellicle is thin, and the endoplasm contains siderophil spherules, and two round nuclei. Each nucleus has four large chromosomes (macrochromosomes of Metcalf), and several microchromosomes. Division is oblique, parallel to the lines of insertion of the cilia. S. D. K.

Infection of the Central Nervous System with *Schizotrypanum cruzi*.

—E. VILLELA and M. C. TORRES ("Estudo histo-pathologico do systema nervoso central em paralyasia experimental determinada pelo *Schizotrypanum cruzi*," *Memorias do Instit. Oswaldo Cruzi*, 1926, **19**, 175-199, 13 pls.). Adult dogs inoculated with *Schizotrypanum cruzi* isolated from the armadillo *Tatus novencinctus* L. exhibit an encephalomyelitis. Small foci are found in the grey and white matter of the brain and cord in the neighbourhood of the small capillaries. The foci are made up of macrophages, some evidently migrated from the vessels, others from the microglia of the region. The disintegration of the brain substance, the formation of fatty granular cells and their subsequent dispersal and finally cicatricial fibrosis are successive stages in the evolution of the foci. *Schizotrypanum cruzi*, with the appearance of a Leishmania, is often found within the cytoplasm of cells in the foci. The vessels show an infiltration of the adventitia with macrophages, lymphocytes and plasma-cells. The latter cells are never the dominant type of cell as in sleeping sickness. Purkinje's cells of the cerebellum and large pyramidal cells of the cortex show swelling of the cellular body, perinuclear chromatolysis and necrosis.

G. M. F.

Natural Infection of a Dog by *Schizotrypanum cruzi*.—S. MAZZA

("Infection spontanée du chien par le *Schizotrypanum cruzi*," *C. r. Soc. de Biol.*, 1926, **95**, 809-11). In Perico in the Argentine *S. cruzi* was found occurring naturally in the blood of a young dog which was in poor condition. The people of the house, and the Amblyomas on the dog were not infected, but crithidia occurred in the Triatomas in the house. No human infection was found in Perico, but 70 p.c. of the Triatomas were infected.

S. D. K.

***Entamoeba pimelodi*, n. sp.—A. M. DA CUNHA and J. C. N. PENIDO**

("Entamoeba pimelodi, n. sp., Parasite d'un poisson d'eau douce," *C. r. Soc. de Biol.*, 1926, **95**, 1010-11, 4 text-figs.). This entamoeba, parasitic in *Pimelodus clarias* L., measures 38-75 across; the ectoplasm and endoplasm are not very distinct. The nucleus is ovoid, with an excentric karyosome, and the chromatin is either scattered or arranged around the membrane.

S. D. K.

A New Ciliate.—C. C. HENTSCHEL ("On a new Ciliate *Ptyssostoma thalassemae*, n. g., n. sp., from the Intestine of the Echiuroid Worm, *Thalassema neptuni* Gärtner," *J. Marine Biol. Assn.*, 1927, **14**, 651-655). A new species of ciliate, *Ptyssostoma thalassemae*, is described from Plymouth as an inhabitant of the intestine of *Thalassema neptuni* Gärtner. The dimensions are 75-100 μ by 55-75 μ . It is a somewhat flattened holotrichous gymnostomatous ciliate, with one side more convex than the other; the mouth situated about a quarter the way from the anterior end, consisting of a kidney-shaped, folded apparatus, supported by a horseshoe-shaped skeletal loop with the gullet running obliquely into the endoplasm at a different level; cilia arranged in about thirty-five longitudinal rows, with a group of a few long cilia at the posterior end; anterior end of the body modified into a mobile prominence; meganucleus in the centre of the body, irregularly spherical; micronucleus apparently lying laterally to the meganucleus and generally hidden; contractile vacuole conspicuous and at posterior end.

G. M. F.

Locomotion in *Amoeba proteus*.—H. T. FOLGER ("The Effects of Mechanical Shock on Locomotion in *Amoeba proteus*," *J. Morph. and Physiol.*, 1926, **5**, 42). *Amoeba* responds to a mechanical shock by a cessation of movement which occurs shortly after the application of the stimulus. The

length of the reaction time, the period intervening between the application of stimulus and the response varied inversely with the magnitude of the shock. A certain amount of time must elapse after a reaction before another can be obtained; during this time the animal reverts to the physiological state which existed prior to the first shock. Partial recovery from the effects of a shock is manifested by a reaction time that is longer than after partial recovery and a period of quiescence which is shorter. A shock in itself too slight to cause a cessation of movement may result in a lack of response to a heavier one coming immediately after. If the second shock, however, is made sufficiently heavy it will bring about a response despite the effects of the first, as would be expected if the reactions take place in accordance with the Weber-Fœchner law.

G. M. F.

Studies on Bird Malaria.—L. G. TALIAFERRO ("Infection and Resistance in Bird Malaria, with Special Reference to Periodicity and Rate of Reproduction of the Parasite," *Am. J. Hyg.*, 1925, 5, 742–89). The length of the asexual cycle in a recently isolated strain of *Plasmodium praecox* was approximately 24 hours. In another strain, after 11 years of continuous sub-inoculation the length of the asexual cycle was 30 hours. A small proportion of schizonts always precede and a few others follow the majority in their time of sporulation and development. The percentage of gametocytes during the acute period of infection is around 3 p.c., but there is a marked increase—2–50 p.c. during relapse and sometimes during the chronic period. By plotting the mean size of the parasites at 4-hour intervals and noting the time which elapses between its high points when only schizonts exist in the blood, a measure of the asexual cycle is obtained. This is also a measure of the rate of reproduction which is independent of any condition which may destroy large numbers of parasites. Using the measure of the rate of reproduction it was found that the rate did not change when the parasites were studied during (1) the acute stage of the infection; (2) the first large destruction of the parasites; (3) the chronic stage; (4) the relapse stage brought about by administering adrenalin chloride. The different parts of the cycle, during relapse occurred at precisely the same hours of the day as the same parts of the cycle had previously occurred in the acute and chronic periods. This evidence is that the asexual cycle had proceeded uninterruptedly and at the same rate throughout the latent period, probably in the internal organs.

G. M. F.

Hydrogen-ion Concentration in the Food Vacuoles of Protozoa. N. H. SHAPIRO ("The Cycle of Hydrogen-ion Concentration in the Food Vacuoles of Paramecium, Vorticella and Stylonychia," *Trans. Amer. Micr. Soc.*, 1927, 46, 45–53, 1 pl.). At a pH of 7.0 in the surrounding medium, the food vacuoles of Paramecium pass through a definite cycle of acidity, beginning with a pH of approximately 7.6 (alkaline stage), soon reaching a maximum of acidity (pH 4.0) while still in the posterior half of the animal and later decreasing in acidity, reaching a pH of about 7.0 prior to excretion. External variations in hydrogen-ion concentration have a slight effect on the pH cycle of the vacuole. Acid cultures tend to decrease the alkalinity of the initial stage. In Vorticella the range of pH observed in the vacuoles is estimated at pH 4.5–7.0. In Stylonychia the range is from pH 4.8 to 7.0 as closely as could be determined. Four different indicators (phenol red, Congo red, neutral red and litmus) were used to check each other in determining the pH ranges of the food vacuoles in the animals studied. G. M. F.

Action of Narcotics on Amœba.—S. HILLER ("Action of Narcotics on the Amœba by means of Microinjection and Immersion," *Proc. Soc. Exp. Biol. and*

Med., 1927, **24**, 427-428). The influence of the following narcotics was studied, viz., ethyl alcohol, chloretone, ether and chloroform on the protoplasm of *Amœba dubia*. Amœbæ immersed in very weak concentrations spread out and continue their movements in an expanded condition, possibly as the result of lowered surface tension. Lethal concentrations of all the narcotics cause the Amœba to round up followed by a sinking of its granules and a disintegration of the plasma-lemma. No narcotic effect was observed by injection into the interior of the Amœba. Chloretone in all concentrations increases the fluidity and streaming movements of the interior. Alcohol 80 p.c. cause a coagulation which is localized and reversible when small amounts are injected and irreversible with large amounts. Pure chloroform and ether, when injected into the cytoplasm, form spherical drops which go into solution more rapidly than when injected into water. The protoplasm is irreversibly coagulated in the environment of the dissolving droplet. Chloroform is more potent than ether in causing coagulation. The irreversible coagula produced by alcohol, chloroform and ether are pinched off by the living portion of the Amœba.

G. M. F.

Bicosoea Kepneri, sp. nov.—B. D. REYNOLDS (" *Bicosoea Kepneri* sp. nov.," *Trans. Amer. Micro. Soc.*, 1927, **46**, 54-9, 1 pl.). Many minute flagellates were found attached to the algal filaments of an old Petri-dish culture of *Oedogonium*. The organisms resemble *Bicosoea lacustris* James-Clark, but differ in being greyish-white in colour instead of yellow; having one instead of two contractile vacuoles, showing no preference for *Zygnema* and having a shell length from 5-10 μ less.

G. M. F.

Vital Stains and Protozoa.—E. R. BECKER (" Vital Staining and Reduction of Vital Stains by Protozoa," *Biol. Bull.*, 1926, **50**, 235-238). *Opalina* has the power of reducing the vital dyes Janus green, brilliant cresyl-blue, Nile blue, toluidine blue and methylene blue. *Paramecium* has similar properties. This shows the presence of a reductase in the protoplasm of protozoa. The wood-ingesting protozoa of the termites' intestine possess a reductase in the food vacuoles since Janus green is reduced in these parts of the cell. The possession of this reductase is not an adaptation to the parasitic mode of life in the intestine where the oxygen pressure is low for free living protozoa may also possess it.

G. M. F.

Protozoa and Utricularia.—R. W. HEGNER (" The Interrelations of Protozoa and the Utricles of Utricularia," *Biol. Bull.*, 1926, **50**, 239-270, 3 text-figs.). Organisms do not force their way into the utricles of Utricularia but are captured by them. The bladders do not select their prey, but any organism small enough to enter the vestibule may be captured, even organisms as small as *Chilomonas paramecium* (24 μ in length). The protozoa found in the bladders are not intruders but captives, and probably free-living species. Some of the captured protozoa live successfully within (*Euglena*, *Heteronema*, *Phacus*), some slowly starve to death (*Centropyxis*), others are quickly killed and digested (*Paramecium*, *Stentor*, *Stylonychia*, *Colpidium*).

G. M. F.

Protozoa and the Pitcher Plant.—R. W. HEGNER (" The Protozoa of the Pitcher Plant *Sarracenia purpurea*," *Biol. Bull.*, 1926, **50**, 271-276). Examination of the liquid from pitcher plants shows the presence of amœbæ, ciliates and flagellates. Some of these may be free living forms introduced by insects visiting the pitcher plant, others may be specially adapted to the pitcher plant. Experiments were carried out to determine whether protozoa were able to survive in the liquid of the

pitcher plant. It was found that paramecia, colpoda and chilomonas are able both to live and multiply within the liquid either outside or within the pitchers of various ages borne by vigorous plants for an indefinite period without injury.

G. M. F.

The Excretory Apparatus of Protozoa.—D. NASSONOV ("Zur Frage über den Bau und die Bedeutung des lipoiden Exkretionsapparats bei Protozoa," *Zeit. f. Zellf. u. mikr. Anat.*, 1925, 2). Continuing recent studies of protozoan structure with osmic methods, in *Chilodon* sp. and *Dogielella sphaerii* a lipoidal structure associated with the contractile vacuole is found. This consists of an irregular ring encircling the vacuole at diastole, and, at systole, remaining unaltered in position and extent. After systole small vacuoles appear in the osmophil material; these run together and fuse up to form the contractile vacuole once more. Two properties may be assigned to the ring (1) concentration in its interior of water and osmotically active substances and action upon them; (2) semi-permeability, to isolate them from the cytoplasm. This second property is only called into play during the production of the vacuoles, after which the main vacuole lies freely in the cytoplasm. A perfect analogy is drawn between this apparatus and the Golgi apparatus of many epidermal and gland cells of the Metazoa.

L. A. H.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

Including Cell-Contents.

Mechanism of Nuclear Division in Pollen.—O. ROSENBERG ("Zum Mechanismus der diploiden Kernteilung in Pollenmutterzellen," *Ark. Botan., Stockholm*, 1926, 20, B. no. 2, 1-5, 2 figs.). A description of the conditions accompanying nuclear division in the pollen-mother-cells of different species of *Hieracium*. It appears that the same special physiological conditions which cause a delay in semi-heterotypic division and the formation of "regression-nuclei" with interkinesis chromosomes, influence the surrounding cells, so that although "regression-nuclei" are not formed in them, yet longitudinal splitting of the chromosomes is induced. The writer considers that these observations confirm the views of Boveri and other authors, that the tetrad-division represents two different processes—the reduction-division and the homotypic division. The latter is a somatic division; the former is a process involving the usual mechanism of nuclear division for the separation of the conjugating chromosomes. The origin of diploid embryo-sacs is probably to be traced to a delay in some stage of nuclear division, and even diploid gametes may be caused in a similar manner. S. G.

Plastids and Chondriome in Gagea.—S. KRUPKO ("Les Plastids et le Chondriome pendant la gonogenèse dans le *Gagea lutea* L.," *Acta Soc. Botan. Polon.*, 1926, IV, 77-86, 2 pls.). A study of the part played by the male plasma during fertilisation. The pollen-mother-cells and the vegetative plasma of *G. lutea* include small, inactive formations of chondriome and large active elements—the plastids. There is no morphological proof of the absolute independence of these two classes, since no intermediate transition forms have been seen. The plastids have two periods of activity—the first during which fatty substances are secreted and the second during the secretion of starch, which starts immediately after the detachment of the generative cell. The elaioplasts are active during the first period and the amyloplasts during the second period. The plasma of the generative cell of the pollen shows two structural elements, which in spite of their minute size, are readily seen to be dissimilar. S. G.

Kinesis in Eleagnaceæ.—H. SOBOLÉWSKA ("Karjokineza wegetatywna i generatywna u Eleagnaceæ," *Acta Soc. Botan. Polon.*, 1926, IV., 64-76, 3 pls., 2 figs.). A study of kinesis during somatic and maturation divisions in two species belonging to the Eleagnaceæ—*Hippophæ rhamnoides* and *Eleagnus angustifolia*. The somatic cells of *H. rhamnoides* have twenty chromosomes, while those of *E. angustifolia* have only twelve. In both cases the chromosomes are of three sizes. In *H. rhamnoides* there are two megachromosomes, twelve mesochromosomes and six microchromosomes. In *E. angustifolia* there are two megachromosomes, eight

mesochromosomes and two microchromosomes. During heterotypic division in the pollen-mother-cells megachromosomes can be seen in the equatorial plate in both plants. The differences between the meso- and microchromosomes are much less distinct than during somatic kinesis. The heterotypic and homotypic divisions give rise to cells with four nuclei, the ultimate fate of which cannot at present be stated. S. G.

Chromosomes of *Rumex*.—T. ONO ("Grossenverhältnis der Geschlechtschromosomen von *Rumex Acetosa* L.," *Sc. Reports, Tokyo Univ.*, 1926, II., 159–60, 6 figs.). A study of the sex-chromosomes of *R. acetosa* L. during heterotypic division. In plants and animals the chromosomes at this stage of division are each composed of an X and a Y section, the latter being always the smaller in number. In *R. acetosa* and *R. thyrsiflorus* the chromosomes are formed of one X and two Y sections. Careful examination and measurement of these chromosomes in *R. acetosa* shows that the single X section has two arms of unequal length, to each of which is attached a Y section; the shorter section Y is attached to the longer arm and the longer section Y to the shorter arm of X. The combined size of the two Y sections is found to be larger than that of X, the relative conditions being X : Y :: 100 : 139. S. G.

Triploidy in *Primula*.—MASAJIRO IINUMA ("Triploidy of Chromosomes in Garden Varieties of *Primula Sieboldii*," *Sc. Reports, Tokyo Univ.*, 1926, II., 189–195, 3 figs.). An investigation as to the relationship between the size of plants and the nature of the chromosomes. A preliminary study showed that *P. molesta* var. *Fauriæ* had 9 and *P. japonica* 22 haploid chromosomes; *P. nipponica* had 22 and *P. Reintii* had 24 diploid chromosomes. An examination of fourteen varieties of *P. Sieboldii* showed that 11 varieties had 24 diploid chromosomes, while the remaining 3 varieties had 36. There is no perceptible difference between the size of the chromosomes in the varieties having 24 chromosomes and in those having 36, so that the latter varieties appear to be triploid mutants of *P. Sieboldii*. There is no evidence of the existence of tetraploid mutants and the writer regards triploidy in the present species as having been "produced by the union of the diploid germ-cells with the normal haploid cells." Abnormal conditions such as variation of temperature during maturation may have been responsible for the diploid germ-cells. A secondary study showed that the stomata of the triploid varieties are much larger than those of the diploid varieties. The general increase in the size of the cell is reflected in greater size of the whole organ. S. G.

Cytological Study of Healthy and Diseased Tobacco Plants.—B. GOLDSTEIN ("A cytological study of the leaves and growing points of healthy and mosaic-diseased tobacco-plants," *Bull. Torr. Bot. Club*, 1926, 53, 499–599, 12 pls., 4 figs.). A study of the tissues of healthy and diseased tobacco-plants dealing especially with the conspicuous and characteristic intra-cellular bodies found in plants affected by the "Virus Disease" which attacks tobacco, wheat, maize and sugar-cane. In addition the internal cell-modifications and the external symptoms have been observed and correlated. Six distinct mosaic patterns have been found, each of which is associated with a particular stage of growth of the disease, and there is evidence of another or a modified strain of the disease in a further distinct set of patterns. The first type is found in the youngest large leaves, which have dark, vaguely blotched patches, and when examined microscopically the palisade-cells of these areas are found to be in arrested development. The second type is found in the youngest leaves present at the time of inoculation and characterised

by pale-green crinkled patches or pale and vaguely blotched. Type three is known as the narrow "nervisequum" stage, and is found in young leaves which developed from primordia affected by the virus. Type four is associated with leaves developed from an infected growing point, and shows malformation and broad "nervisequum." In type five the leaves are pale and definitely blotched, and in type six the leaves have an irregular, narrow "nervisequum" which often persists until the plant flowers. The mottling found in types one, two and five may be connected with focal centres for the diffusion of toxic products. The coarser blotching of type five suggests that the virus originated at certain points and its effects are diffusing in all directions. The blistered or puckered effect is produced by the division of the cells of the healthy patches, surrounded by diseased cells whose growth is hindered by the presence of the virus. The intra-cellular bodies appear to occur in diseased tissues at all stages of growth. They are distributed during cell-division subsequent to infection, although there is no evidence that they migrate through the cell-walls. They cannot be regarded as disorganised nuclei nor as tannin vesicles. The striated bodies also found in diseased plants of *Nicotiana Tabacum* and *Solanum aculeatissimum* are reaction-products of the cell, and may be compared to cystoliths and similar cell-inclusions. S. G.

Doodia.—P. C. SARBADHIKARI ("Cytology of *Osmunda* and *Doodia*. II. On the Gametophyte and Post-meiotic Mitoses in the Gametophytic Tissue of *Doodia*," *Annals of Botany*, 1927, vol. xli, pp. 1-35, 4 pls.). The author finds the chromosomes of *Doodia* in the postmeiotic divisions of the prothallus to correspond exactly with those of the somatic and premeiotic divisions. They preserve their identity through the resting phase and interphase, and a genetic continuity throughout the life cycle. The definitive splitting of the chromosomes occurs in the telophase, not in the prophase. The prothallus of *Doodia* affords trustworthy evidence of the permanence of the chromosomes in the state of autonomous organic units during the interphase, and so supports the theory of the individuality of the chromosomes. There is no continuous single spireme thread. The phenomena of the telophase of one division are important for the interpretation of those of the early prophase of the next division. The telophasic transformations produce in the chromosome a real chromatic duality. Numerous highly magnified figures of nuclear division are given. A. G.

Structure and Development.

Vegetative.

Correlation between Cotyledon and Axillary Bud.—J. KÖRINEK ("Okorrelacích mezi dělohou a uzlabním pupenem." *Pub. Fac. Sc. Univ. Masaryk*, 1922, 16, 1-19, 2 figs.). A study of the relationship of the cotyledon and its axillary bud with special reference to the work previously done by R. Dostal on the Papilionaceæ. The present paper deals with *Linum usitatissimum*, *Fagopyrum esculentum*, *Helianthus annuus*, *Cannabis sativa*, *Mirabilis jalappa*, etc. It is found that when the main stem and a cotyledon are removed, the axillary bud develops, but rarely forms a stem of the same size as the one removed, probably because half the nutritive material is lacking. In *Linum* only the bud in the axil of the uninjured cotyledon develops; in *Fagopyrum* the bud on the injured side appears to have equal chances of abortion or growth. In plants with unequal cotyledons, such as *Cannabis*, the bud of the smaller cotyledon develops if only the main stem is removed; if a cotyledon is also removed the bud in the axil of the uninjured

cotyledon grows. In *Pisum* the whole of one cotyledon was removed and part of the other; the bud in the axil of the missing cotyledon showed the greater development. If the main stem is removed and the cotyledons are left intact the two axillary buds show unequal growth. In one series of experiments the main stem, one cotyledon and its bud were removed, while in a corresponding series, the other bud was removed. In both series the weights of the stems from the growing buds were the same, showing that the growth of the bud is independent of the cotyledon. From the experiments performed it is difficult to make a general statement, but the author suggests that the removal of the cotyledon acts as a stimulus to the growth of the axillary bud. If there is sufficient food still left its bud grows; if there is insufficient food (especially in green cotyledons), the bud nearest the reserve of food grows better, although it has received no stimulus.

S. G.

Asymbiosis in Orchids.—J. COSTANTIN ("La vie asymbiotique des orchidées." *Ann. Sc. Natur. Botan.*, Ser. X., 1926, VIII, i-xvi, 1 fig.). A résumé and discussion of the work done by several writers in connection with the symbiotic life of orchids which usually live symbiotically with a fungus. The author regards the work of M. Bultel as inconclusive; it does not prove that asymbiotic plants can produce flowers, nor that they are unable to produce them, although most of the evidence favours the latter view. In order to prove with certainty that asymbiotic plants are sterile, long and expensive experiments are necessary. The writer regards it as unlikely that such experiments would be undertaken for a purely negative result, although the evidence gained would probably have a far-reaching effect upon the biology and perhaps the pathology of saprophytic plants.

S. G.

Structure of Timber in Saxifragaceæ.—M. B. WELCH ("Notes on the Principal Indigenous Timbers of the Natural Order Saxifragaceæ." *Proc. Roy. Soc., N.S. Wales*, 1925, 59, 276-292, 5 pls.). A description of the macroscopical and microscopical characters and other diagnostic features of nine species belonging to eight genera of the Saxifragaceæ. There is a photomicrograph of each species and a key for their identification.

B. J. R.

Identification of Timber of Eucalyptus.—M. B. WELCH ("The Identification of the Principal Ironbarks and Allied Woods." *Proc. Roy. Soc. N.S. Wales*, 1925, 59, 329-345, 2 pls., 4 figs.). About twenty species of *Eucalyptus* fall into the class *Schizophloieæ* or Ironbarks, characterised by their hard, rough, deeply furrowed bark. Those most valued for their timber are *E. paniculata* Sm., *E. crebra* F. v. M., *E. siderophloia* Benth., *E. sideroxylon* A. Cunn. Frequently confused with these are the woods of two species of smooth-barked Grey Gums, *E. punctata* D.C. and *E. propinqua* D. & M. The anatomy of these six species is described and figured and the results of the investigation summarised in a key.

B. J. R.

Distribution of Tannin in Callitris.—F. A. COOMBS and M. B. WELCH ("The Tannins of the Black Cypress Pine, *Callitris calcarata* R. Br., and their distribution in the Bark." *Proc. Roy. Soc. N.S. Wales*, 1925, 59, 356-382, 2 pls.). This species yields an important tannin-bearing bark available in large quantities. Tannin occurs principally in the phloem parenchyma, in the medullary ray cells and in the epithelial cells lining the resin passages. It was not observed in the bast fibres or sieve tubes. The tannin is readily soluble in water in the inner living bark, but becomes progressively less soluble in the outer portion, finally becoming practically insoluble towards the outside, the cells being filled with a

brownish amorphous phlobaphene-like body. The extraction of the tannin on a practical scale gave results which showed that a considerable amount was destroyed. Although analyses of individual barks have shown up to almost 37 p.c. tannin, the figure obtained from commercial samples is in the vicinity of 20–25 p.c. tannin. Suggestions for improving the commercial method of extraction through the use of finely ground powder are outlined. B. J. R.

Tropical American Trees and Timber.—S. J. RECORD ("Notes on Trees and Timbers of Tropical America." *Tropical Woods*, 1926, 7, 10–28 and 8, 9 and 11–17.) Nearly one hundred species are included in notes on the occurrence, systemat, anatomy and utilization of the trees of the Lower Rio Montagna Valley of Guatemala. There is also a check list of common names. Wood specimens of three species of *Ilex* were found to be without the spiral fibre-tracheids and vessels hitherto thought to be characteristic of the genus. The species are *I. Martiniana* D. Don, *I. casiquiarensis* Loes., *I. pulogensis* Merr. Three tree species are described with special reference to their wood structure—*Saurauia villosa* D.C., *Krugiodendron ferreum* (Vahl) Urban, *Kaerberlinia spinosa* Zucc. B. J. R.

Reproductive.

Development of the Integuments of the Ovule and Seed of Podophyllum.—K. LUBLINEROWNA ("Orozwoju okryw zalazkowych i nasiennych w rodzaju *Podophyllum*," *Acta Soc. Botan. Polon.*, 1926, III, 277–282, 1 fig., 1 pl.) A study of the development of the macrospore and the integuments of the ovule and seed in *Podophyllum*. The macrospore is described in another paper, while the present one deals only with the integuments. The two species studied were *P. peltatum* and *P. Emodi*, and it is found that the inner integument consists of two layers of cells. After fertilisation this integument disappears, being crushed between the outer integument and the endosperm. The outer integument becomes the external coat of the seed, that of *P. peltatum* being thinner than that of *P. Emodi*. The growth of the embryo-sac destroys the tissues of the nucellus—before fertilization by pressure and subsequently by absorption. In *P. Emodi* the epidermis persists forming the innermost layer of the ripe seed-coat. The inner epidermis of the outer coat of the ripe seed of the same species is filled with crystals of calcium oxalate, and serves as a mechanical layer, but this crystalline layer is absent in *P. peltatum*. S. G.

CRYPTOGAMS.

Bryophyta.

Fossombronia.—AMOS M. SHOWALTER ("Studies in the Cytology of the Anacrogynæ. III. Fertilization in *Fossombronia angulosa*," *Annals of Botany*, 1927, vol. xli, pp. 37–46, 2 pls. and 4 figs.). The author finds that the antherozoid of *Fossombronia angulosa* penetrates the egg instantaneously, more than one antherozoid entering the same egg. Not for about thirty hours does the egg show any significant change. Some forty-two to sixty hours after insemination, the paternal chromatin may sometimes be shown distinguishable from the maternal in the fusion nucleus. The zygote increases greatly in size, and undergoes the first division from six to nine days after fertilization. The form of the young embryo varies greatly. The eggs of *Fossombronia* are penetrated by antherozoids of *Riccardia*, *Sphaerocarpus*, and *Funaria*. A. G.

Rhizoids of Lunularia.—OTTO GERTZ ("Zur Physiologie der Rhizoidenbildung bei den Brutkörpern von *Lunularia cruciata* (L.), Dum.," *Lunds Universitets Årsskrift*, 1926, N.F. Avd. 2, Bd. 22, Nr. 3, pp. 1–63, 5 figs.). An account of the physiology of rhizoid formation on the gemmæ of *Lunularia cruciata*. More than 200 experiments were made at Heidelberg with the cultivation of the gemmæ under various conditions, in order to test how rhizoid formation is influenced by various factors, such as water, moist air, salts and organic compounds—singly and in combination, light, gravity, plasmolysis, injury, poison, etc. The tropism, growth and anomalies of the rhizoids are considered. A. G.

Mielichhoferia.—EDWIN B. BARTRAM ("Notes on Mielichhoferia," *Bull. Torrey Bot. Club*, 1927, vol. 54, pp. 31–34, 1 pl.). An account of *Mielichhoferia macrocarpa* var. *pungens*, a new variety from Utah, Wasatch Mts., in or by caves. The structure of the moss is shown in several figures; and figures of the leaves of *M. macrocarpa* and *M. cuspidifera* are given for comparison. A. G.

Thallophyta.

Algæ.

New Chlamydomonads.—F. E. FRITSCH and FLORENCE RICH ("On Some New Species of Chlamydomonadaceæ," *Annals of Botany*, 1927, vol. xli, pp. 91–99, 3 figs.). Descriptions of three new species of Chlamydomonadaceæ, obtained from a vessel of liquid manure at the Museum, Kimberley. *Polytoma caudata* is essentially distinguished by its shape; *Chlamydomonas dorsiventralis* has a marked dorsiventral construction, involving not only the shape of the cell, but also the arrangement of its parietal plate-shaped chloroplast; *Chl. truncata* is peculiar in the truncation of the anterior end and an apparently dominant Palmella stage. A. G.

Phytoplankton of Pond Waters.—EINAR NAUMANN ("Undersökningar öfver Fytoplankton i Dammar vid Aneboda Fiskeriförsöksstation Åren 1911–1920," *Lunds Universitets Årsskrift*, 1925, N.F. Avd. 2, Bd. 21, Nr. 1, pp. 1–68, 2 pls. and 10 figs.). The author discusses the nature of the pond waters of Aneboda and their flora, giving a systematic list of their phytoplankton; he describes the phases and characteristics of the species and their periodicity, and the effect of drainage conditions. A. G.

Crinalium.—W. B. CROW ("Crinalium, a new genus of Cyanophyceæ, and its bearing on the Morphology of the group," *Annals of Botany*, 1927, vol. xli, pp. 161–165, 2 figs.). The new genus and species here described, *Crinalium endophyticum*, is a member of the Oscillatoriaceæ. Its filaments were found endophytic in colonies of *Aphanocapsa fonticola* Hansg., on the damp face of a rock in North Wales. It has a sheath, and its filaments are distinguished from *Lyngbya* in being doubled and flattened. There is a tendency to spiral coiling, but less than in *Spirulina*. Points of resemblance to Rivulariaceæ and to Spirochaetaceæ were also observed. A. G.

Gelatine Structures of Pond Phytoplankton.—EINAR NAUMANN ("Die Gallertbildungen des pflanzlichen Limnoplanktons. Eine morphologisch-ökologische Übersicht," *Lunds Universitets Årsskrift*, 1925, N.F. Avd. 2, Bd. 21, Nr. 5, pp. 1–26, 2 pls. and 2 figs.). The importance of gelatin excretion in the life-history of freshwater phytoplankton is insisted upon by the author, who describes the general morphology and ecology of the gelatin of the cell wall, of reproduction,

of protection, and illustrates his paper with several photomicrographs of *Anabæna*, *Microcystis*, *Glæotrichia*, *Chroococcus*, *Aphanothece*, and other plankton algæ. He points out that there are many questions which call for investigation. A. G.

Peculiar Constituent of Nostoc Gelatin.—OTTO GERTZ and EINAR NAUMANN ("Über das Vorkommen einer eigenartigen chemischen Ausscheidung in der Gallerthülle von *Nostoc Zetterstedtii* J. E. Aresch.," *Lunds Universitets Årsskrift*, 1925, N.F., Avd. 2. Bd. 21, Nr. 2, pp. 1-12, 3 pls.). A discussion of the very peculiar bodies found in the gelatinous wall of *Nostoc Zetterstedtii*, which have been the subject of a special investigation by the authors. The different forms of *Nostoc* thallus are described, as also the mode of occurrence of the bodies in the gelatin. An account is given of the chemical tests applied to determine the nature of the bodies and of the results. The bodies are found to be cyclic nitrogenous organic compounds which cannot, however, be conclusively identified with albumen. They are found, not in merely vegetative thalli, but in older thalli in which spore formation has occurred, and appear to represent the débris of the albuminous stores thrown aside after spore formation. A. G.

Microdictyon.—WILLIAM ALBERT SETCHELL ("Notes on Microdictyon. II.," *Univ. of California Publications in Botany*, 1926, vol. 13, pp. 147-153). A second contribution to the complex question of the species of *Microdictyon*, with a revised analytical key to the sections of the genus and to the species. The species are now considered to be eighteen in number, three novelties being described, namely *M. laxereticulatum* from Naples, *M. Thiebautii* from Loyalty Islands, *M. Vanbosseæ* from Malaya. A. G.

Padina Pavonia.—P. W. CARTER ("The Life-History of *Padina Pavonia*. I. The Structure and Cytology of the tetrasporangial plant," *Annals of Botany*, 1927, vol. xli, pp. 139-159, 2 pls. and 4 figs.). The author describes his methods of investigation, and gives an account of the following:—Mode of growth and origin of hairs; early development of tetrasporangium; heterotype or first meiotic division of the tetraspore mothercell nucleus; synizesis; hollow spireme to resting stage; resting or growth stage; conjunction; diakinesis; heterotypic spindle; homotypic or second meiotic division; tetraspore formation; germinating tetraspores; abnormalities. Highly magnified figures are supplied. A. G.

Floridean Studies.—L. G. SJÖSTEDT ("Floridean Studies," *Lunds Universitets Årsskrift*, 1926, N.F. Avd. 2, Bd. 22, Nr. 4, pp. 1-95, 42 figs.). A morphologico-systematic study of the Cryptonemiales, Rhodomeniales and Gigartinales, including the creation of *Acrosymphyton*, a new genus of Dumontiaceæ. A discussion of F. Schmitz's system in view of recent investigations of Floridean life-history. An attempt to outline a more natural classification of the diplobiont Florideæ. An historical outline of Floridean classification. A. G.

Nitophyllum.—A. H. S. LUCAS ("Notes on Australian Marine Algæ. III. The Australian Species of the Genus *Nitophyllum*," *Proc. Linn. Soc. New South Wales for 1926*, vol. LI, Part 4, pp. 594-607, 9 plates). An account of *Nitophyllum* as known in Australian waters, with a description of the genus, a definition of J. G. Agardh's four subgenera—*Leptostroma* (a Mediterranean group), *Aglaophyllum*, *Cryptoneura*, *Polyneura*, and descriptions of the twenty-two species recorded for Australia, and of two others to which some doubt attaches. The distribution is indicated and a series of photographic figures of the plants and drawings of details are supplied. A. G.

Algæ of Tahiti.—WILLIAM ALBERT SETCHELL ("Phytogeographical Notes on Tahiti. II. Marine Vegetation." *Univ. California Publications in Botany*, 1926, vol. 12, pp. 291–324). The marine algæ recorded for Tahiti are 149 species. These belong to genera of wide distribution, mostly in Indo-Pacific, partly in Atlantic waters. Nearly all the species belong to the littoral zone. The *Lithothamnizæ*, especially *Porolithon onkodes*, are the reef-forming algæ; some of the reefs may be 180,000 to 300,000 years old. A. G.

Fungi.

Phycomycetes in Hungary.—F. GIMESI NANDOR ("Beiträge zur Kenntnis der Phycomyceten in Ungarn. Hydrobiologiai Tanulmányok." Hydrobiologischen Studien II. *Phlyctidium Eudorinæ*, Gim., n.sp., Budapest, 1924, 1–8, 8 text-figs., 1 pl. Hungarian and German). The author has given a full German translation of his paper. He discovered the alga, *Eudorina elegans*, in a lake at Budapest, and found that it was parasitized with a Phycomycete. A description is given of the fungus infesting the *Eudorina*, and of the sporangia and swarm cells. The development and cytology is described and the copulation of the gametes, with the resulting cyst formation. Reasons are given why the author considers this to be a new species. A. L. S.

Rhopalomyces elegans Corda.—K. B. BOEDIGN (*Ann. Mycol.*, 1927, 25, 161–6, 4 text-figs.). The genus *Rhopalomyces* produces a swollen head at the end of the conidial hypha; the head is areolate, and from each areola rises a sterigma and conidium. Boedign has come to the conclusion that the species *Rh. elegans* is not a Hyphomycete, and he places it among Phycomycetes, partly on account of the root-forming base of the sporophore, something like a *Rhizopus*, and also because the large so-called conidia are multinucleate and are akin to *Syncephalis*. A. L. S.

Witches' Broom.—ANNIE RATHBURN-GRAVATTI ("A Witches' Broom of Introduced Japanese Cherry Trees," *Phytopathology*, 1927, 17, 19–24, 1 text-fig.). These cherry trees are much valued in horticulture in America, and have been widely grown. The witches' broom was first detected at Washington, and the causal agent was diagnosed as *Exoascus Cerasi*. When infected the trees have peculiar bunchy crowns. Infected twigs bear no flowers, and the leaves are undersized and crinkled. The disease spreads so slowly that it was found possible to eradicate it by pruning and so destroying the affected parts. A. L. S.

Study of Ascoidea.—H. LOHWAG ("Zur Homologisierung der Konidien von *Ascoidea*," *Biologia Generalis*, 1926, 2, 835–64, 29 text-figs.). In this study Lohwag has sought to reach a clear understanding of the nature of the conidia in this primitive Ascomycete in which the asci (or sporangia) bear lateral conidia. He considers these conidia to be undeveloped sporangia. He has summed up all the evidence for this theory, contrasting and comparing developments in other families and genera. A. L. S.

Studies on Bermuda Fungi I. *Poronia leporina*.—F. J. SEAVER, H. H. WHETZEL and CYNTHIA WESTCOTT (*Mycologia*, 1927, 19, 43–50, 1 pl., 5 text-figs.). The fungus first determined by Ellis and Everhart, and later recorded from Yorkshire, England, was discovered on the excrement of rabbits in Bermuda. Cultures were made and the fungus is now carefully and fully described. A. L. S.

Study of Stromata.—WALTER LEROY BLAIN ("Comparative Morphology of Dothideaceous and kindred Stromata," *Mycologia*, 1927, 19, 1-20, 3 pls.). The author explains that though the work carried out is important from a taxonomic or phylogenetic standpoint, it has not been possible for him to pursue the inquiry on these lines. He has devoted his attention to the general morphology of the structures mostly in Dothideaceæ, with special regard to the loculiferous regions, the extra loculiferous and the hypostroma, the latter lying in the substratum or host tissue. He employed as a stain Pianezze III b. Details are given of these different parts of the stroma; some are in the nature of a mycelium, others take the form of rind of dense black "stroma," two or three cells thick. No definite ostiole was found except in the Sphæriales. The hypostroma may be merely mycelial threads permeating the host tissues, or more dense bodies mycelial or stromatoid. A bibliography of papers (21 in all) that have touched on this question is appended. The plates represent mainly the position of the perithecia within the stromata.
A. L. S.

Pezizaceæ.—FRED J. SEAVER ("A Tentative Scheme for the Treatment of the Genera of the Pezizaceæ," *Mycologia*, 1927, 19, 86-9). The writer states that for many years he has made a study of the operculate cup-fungi of North America, and the scheme of classification and nomenclature here outlined is such as he proposes to publish in a forthcoming monograph. He regards priority as all important, and refuses to consider the claims of "common usage"; he adheres to the American code rather than to the International code. He thus abolishes the old-established genus *Lachnea*, since that name is in use as a genus of flowering plants, but he retains the tribe-name Lachneæ, while substituting *Patella* for *Lachnea*. *Patella* had been proposed by Weber in 1780.
A. L. S.

Scolecobasidium.—E. V. ABBOTT ("*Scolecobasidium*, A New Genus of Soil Fungi," *Mycologia*, 1927, 19, 29-31, 1 text-fig., 1 pl.). The author describes two species of the new genus, both isolated from soil in Louisiana. They were cultivated on an acidified synthetic agar; there is a creeping mycelium, with, at intervals, upright conidispores tipped by sterigmata (2 or 3) bearing brown (1) septate spores. The species differ in the form of the spores. The author has placed the genus along with the Dematiaceæ-Didymosporeæ.
A. L. S.

South American Rusts.—H. S. JACKSON ("The Rusts of South America Based on the Holway Collections II," *Mycologia*, 1927, 19, 51-65). The rusts are described according to the hosts: thus there are here published the species, numbers, 50 to 82, in the order of host families Salicaceæ to Berberidaceæ. In all cases synonymy is given with notes on occurrence and distribution. A number of new species are described.
A. L. S.

Ustilago Zeæ.—J. J. CHRISTENSEN and E. C. STAKMAN ("Physiologic Specialization and Mutation in *Ustilago Zeæ*," *Phytopathology*, 1926, 16, 979-99, 11 text-figs.). The authors state that *Ustilago Zeæ* comprises a numerous group of physiologic forms, fifteen of which were studied in detail; they were distinguishable in cultures by their rate of growth, colour, zonation, conidial production, etc. Mutants occurred in the cultures, and when transferred remained true to the mutant form; they differed from the parent stock not only in general appearance, but also in pathogenicity. One mutant bred true for at least one and a half years on culture media; its pathogenic capabilities have remained constant for at least six months.
A. L. S.

Ustilago nuda and Ustilago Triticici.—H. A. RODENHISER ("Physiologic Specialization of *Ustilago nuda* and *Ustilago Triticici*," tom. cit., 1001-7). The author has proved by cultures that there is undoubtedly physiologic specialization in the loose smut fungi. The two species *U. nuda* and *U. Triticici* are outwardly alike, but the one infects barley while *U. Triticici* affects wheat. Physiologic variations in both species are on parallel lines; these variants are constant. A. L. S.

Races of Oat Smuts.—GEORGE M. REID ("Further Evidence of Physiologic Races of Oat Smuts," *Mycologia*, 1927, 19, 21-28). The author here continues work he carried out some years ago. Experiments were then made with the loose smut, *Ustilago Avenæ*, and the covered smut *U. levis*. He has repeated experiments with a "Missouri" race of *U. Avenæ*, which had been found to give high percentages of infection in many varieties, as well as with *U. levis*. The results of numerous experiments are tabulated. Other experiments were with a "Fulghum" race and a "Red Rustproof" race, the results of many infections and different species and strains of *Avena* being also chronicled and tabulated. He concludes that "though both *U. Avenæ* and *U. levis* are capable of attacking a large number of varieties of oats, yet they can be differentiated by differences in their capacity for infecting certain varieties." A. L. S.

Relationship of Clathrus and Phallus.—H. LOHWAG ("Die Übergang von *Clathrus* zu *Phallus*," *Arch. Protistenk*, 1924, 49, 237-59). In summing up Lohwag states that *Clathrus* is a compound headed (pileate) fungus form, and *Phallus* is similar to *Clathrus* but with only one pileus or head. The portion of the receptacle called the head in the Phallaceæ is, he holds, homologous with the ring of the Amanitæ and arises from the thick basal tissue of the firm volva. The original peg-shaped fertile trama tissue may become branched, hence the chambered condition of the fruiting bodies. Further, that the peg form of the hymenophore points to the derivation of the Phalloideæ from the early stages of the Hydnaceæ. *Montagnites* is also related to the Phallaceæ. A. L. S.

Gasteromycetes of Australasia VI. The Genus Lycoperdon.—G. H. CUNNINGHAM (*Proc. Linn. Soc., New South Wales*, 1926, 51, 627-42, 3 pls.). Cunningham has published a comprehensive study of *Lycoperdon*, the material having been secured from New Zealand, Tasmania, and Australia. He has had to grapple with many redundant species and many loose descriptions. He embodies in a key the characters that, in his view, distinguish the species, chief among them spores and capillitium. *Lycoperdon* is a world-wide genus, but is most abundant in temperate climates. The structure is described, then follows a diagnosis of the genus and a systematic account of fourteen species: six species have been found only in Australasia, six species are found in Britain, as well as other countries, the remaining two species are of wide distribution, but not European. A. L. S.

Development of Geaster velutinus.—G. H. CUNNINGHAM (*Trans. Brit. Mycol. Soc.*, 1927, 12, 12-20, 9 text-figs.). *Geaster velutinus* is a common fungus in New Zealand and Cunningham was easily able to secure a series of plants from the earliest stages onwards. Before splitting into stellate rays *Geaster* has a globose form. The author describes the exoperidium or splitting covering; the endoperidium is also described in great detail, as it directly encloses the gleba; basidial development was followed throughout. Hyphæ are all uninucleate, but with the beginning of spore formation the nuclei divide until the number of them is equal to the number of spores to be produced. All attempts to germinate spores failed. No clamp connections were observed, and no spore fusions. A. L. S.

Systematic Position of *Secotium*.—H. LOHWAG ("Entwicklungs-geschichte und systematische Stellung von *Secotium agaricoides* (Czern.) Holl.," *Oesterr. Bot. Zeitsch.*, 1924, 161-74). Lohwag gives a detailed account of this rather small fungus, with a columella narrow at the base and broadening upwards. He finds that the hymenium bears cystidia which disappear on maturity, and that there is a true stalk and pileus. It is a true Gasteromycete near to the Phallacæ. The genus *Elasmomyces* should be separated from *Secotium*. Finally, from the *Secotiæ* are derived the *Lactariæ*, *Agaricacæ* and *Polyporacæ*. A. L. S.

Forest Pathology.—J. S. BOYCE ("Observations on Forest Pathology in Great Britain and Denmark," *Phytopathology*, 1927, 17, 1-18). These observations were made from the point of view of the requirements of American foresters. The writer studied the type forest trees, mainly conifers, and draws certain deductions useful to America: foreign species should be introduced into the States only as seeds, though even that is hazardous. In Britain the planting of 5-needle pines has been discontinued on account of the ravages of white pine blister rust, *Cronartium ribicola*. Boyce emphasises the need, for forest pathologists, of an extensive knowledge of exotic parasites on trees, and he concludes that the introduction of foreign nursery stock is a most dangerous practice. A. L. S.

Concentration of Sap in Fungi.—M. et Mme. LAPICQUE ("Concentration des sucs cellulaires chez les Champignons supérieurs (Agaricinés)," *Comptes Rendus Acad. Sci.*, 1927, 184, 398-401). The writers have made a series of physiological experiments and observations on the concentration of the sap in different parts of the fungus. They find, for instance, that the lamellæ—the hymenium and hymenophore—contains in its cells a sap of special composition with a less osmotic pressure than the cells of the peridium, and they argue that it is not by osmosis that arrives the water with which they are charged in their rapid growth. As they had proved that marine algæ pumped salts against osmotic pressure, so the fungi pump water against a similar pressure. A. L. S.

Mycological Contributions, III.—ERNST GÄUMANN (*Ann. Mycol.*, 1927, 25, 167-77). Gäumann gives studies of various fungi brought by him from Java: they comprise an account of development in *Epichlæ Bambusæ*; a critical study of the genus *Woroninella*, which he considers to be a *Eusynchrytium*; an account of spore formation in *Endophyllum*, with notes on *Septobasidium* and *Peronospora iberidis* n. sp. A. L. S.

Mycological Notes.—E. M. WAKEFIELD ("The Arundel Foray," *Trans. Brit. Mycol. Soc.*, 1927, 12, 1-5). The Mycological Society holds a short fungus foray in spring in order to gain acquaintance with spring fungi. Most of those collected at Arundel were growing on trees either on stem or leaves, mostly also as parasites. Large fungi were scarce, but a fair collection of the lower Basidiomycetes and of micro-fungi was obtained, such as *Uredinæ* and *Pyrenomycetes*. A. L. S.

Fungus Flora of Zurich Botanical Gardens.—HANS SCHINZ ("Beitrag zur Kenntnis der im Botanischen Garten der Universität Zurich, 1905-26, festgestellten Pilze und Moose: Pilze," *Vierteljahrsschrift Naturf. Ges. Zurich*, 1926, 71, 182-93). In this list of fungi growing in the gardens Schinz includes all sections of fungi. The great majority, however, are Agarics (Basidiomycetes) with a few in the Section Gasteromycetes. Plant diseases are evidently kept well in abeyance; there are a few rusts and mildews, but only two representatives of the great group of Fungi Imperfecti, one on Ivy the other on *Hex*. A. L. S.

Parasitic Fungi from the Dominican Republic.—**RAFAEL CIFERRI** and **ROMUALDO GONZALEZ FRAGOSO** (*Bol. Real. Soc. Esp. Hist. Nat.*, 1927, **27**, 68–81, 16 text-figs.). The fungi described by the authors were sent as dried specimens; they describe the methods of treatment and examination, with a view to the elimination of errors due to solutions in which the specimens were prepared, they also include descriptions of the objectives used in measuring. As stated in the title the fungi are all parasites mostly on leaves, and mostly Pyrenomycetes or Sphærospideæ. They have described 16 or more new species, well-illustrated, and all belonging to well-known genera. A. L. S.

Fungi of Santo Domingo, I.—**RAFAEL A. TORO** (*Mycologia*, 1927, **19**, 66–7, 1 pl.). The author gives a historical sketch of Santo Domingo fungi the first account of which was by Berkeley in 1852. There have been records since then, but these are mostly scattered through other mycological literature. Over 400 specimens were collected by Kern and Toro in 1926. The list enumerates 97 species, all of them microfungi; the rusts are to be dealt with in a further paper. A number of species are new to science and are illustrated on the plate. The fungi are parasitic and the hosts are given; one species, *Calonectria rubescens*, was found to be parasitic on the mycelium of *Meliola* which grew on *Banisteria laurifolia*. Synonymy and bibliography are supplied. A. L. S.

Fungi from Costa Rica.—**H. SYDOW** ("Fungi in itinere costaricense collecti. Pars tertia," *Ann. Mycol.*, 1927, **25**, 1–160, 8 text-figs.). This long account of Costarican fungi deals with two classes of Microfungi—Ascomycetes and Fungi Imperfecti. With few exceptions the multitude of species are new to science and are described in great detail. The new genera are:—*Neostomella*, *Synstomella*, *Aphanopeltis*, *Protopeltis*, *Endocycla*, *Melathyriella*, *Perizomatium*, *Orthoscypha* and *Bioscypha* (Ascomycetes); *Pezizomella*, *Pycnostoma*, *Merismella*, *Elachopeltis*, *Acarella*, *Stigmopeltis*, *Stigmopeltella*, and *Plenotrichum* (Sphærospideæ); *Campotomeris*, *Actinodochium*, *Chaetotrichum*, and *Trichodochium* (Hyphomycetes). The great majority are recorded from living leaves of various plants, and therefore should rank as plant diseases. A. L. S.

Entomogenous Fungi.—**T. PETCH** ("Studies in Entomogenous Fungi. XII. *Pezizotrichum Lachnella*; *Ophionectria coccorum*; *Volutella epicoccum*." *Trans. Brit. Mycol. Soc.* 1927, **12**, 44–52, 1 pl.). These three fungi which grow on scale insects are remarkably alike, and Petch has definitely proved the relationship between the first two of which he gives a full historical history and a study of their appearance and development. Finally, he has demonstrated that *Pezizotrichum Lachnella* is a sterile stroma of an *Ophionectria*. The latter was found originally on the insect *Fiorinia juniperi* on *Juniperus bermudiana*. The insect is usually concealed under scale leaves; the fungus spreads over the leaf. The stroma was the condition described as *Pezizotrichum Lachnella*; the perfect stage with perithecia and ascospores is *Ophionectria coccorum* n. sp. The third species, *Volutella epicoccum* n. sp. is probably related to *Ophionectria coccorum*, and may be the conidial stage, but attempts to germinate the conidia have been unsuccessful. All these fungi are fully described and figured. A. L. S.

Fiber Deterioration.—**FELICISIMO B. SERRANO** ("Deterioration of Abaca (Manila Hemp) Fiber through Mold Action," *Philippine Journ. Sci.* 1927, **32**, 75–101, 10 pls., 2 text-figs.). Defective Manila hemp was first noted in 1902 and

the trouble was then referred as due to long storage. Serrano has here given an account of his experiments and observations on the subject. Deterioration was not confined to any one region, though those from one place, Bicol, were more seriously affected. The abaca plant in certain districts is affected with root-rot and heart-rot, but though the fibres from these plants were weakened, they had not suffered from the peculiar deterioration. That was due to cellulose digesting fungal organisms, and Serrano isolated from the fibres *Aspergillus flavus*, *A. fumigatus*, *A. glaucus*, *A. niger*, *A. Wentii*, *Penicillium glaucum*, *Chaetomium elatum*, *C. funicolum* and *C. olivaceum* with var. *chartarum*. Sometimes a species of *Alternaria* was present and also caused damage. The conditions favouring the fungi are: abundant moisture content, poor or partial cleaning, long storage of moist fibre, inadequate ventilation in the warehouses, and lack of care in handling. Elimination of these factors would reduce or entirely remove the trouble.

A. L. S.

Mycophagic Notes.—W. A. MURRELL and JOHN DEARNESS (*Mycologia*, 1927, 19, 92-96). Murrill gives his experience in the use of *Leotia* as an edible fungus. It has a slight acid taste and no particular flavour, but it causes no unpleasantness, and in urgent cases might be used as food without any fear of poisoning. John Dearness describes cases of poisoning by *Amanita* at London, Ontario. The fungi were collected as white mushrooms, cooked and eaten; two men and a seven-year-old child died in spite of remedial treatment. The other persons who shared in the repast recovered after serious attacks of poisoning. Dearness found that several fungi had formed part of the repast, but the poison effect was traced to *Amanita verna*.

A. L. S.

Microbiology in Science and Industry.—A. C. THAYSEN and H. J. BUNKER ("The Microbiology of Cellulose, Hemicelluloses, Pectins and Gums," 1927, VIII, and 363 pp., 23 text figs. Oxford University Press, London, Milford). The authors have compiled a treatise on a difficult and recondite subject: the nature of celluloses, etc., with the organisms that prey on them and the result of their activities. The micro-organisms are classified under Schizomycetes (bacteria) and Eumycetes (microfungi). The activities of the two types of organisms are fairly similar; they are mostly Hyphomycetes and decompose the substances of vegetation by fermentation or other processes, and their activities may be beneficial in disposing of waste vegetation or maleficent in causing plant diseases or the destruction of useful material such as paper cloth or manufactured wood. The Eumycetes are classified and described according to their activities into Group A, those that decompose pectin and hemicelluloses; and Group B, those that decompose cellulose and lignin. Each fungal agent is recorded along with a history of the research on its actions and reactions.

A. L. S.

Conifer Disease.—GLENN GARDNER HAHN ("Phomopsis juniperovora and closely related Strains on Conifers," *Phytopathology*, 1926, 16, 899-914, 3 pls., 1 text-fig.). The writer has carried out a research on the above fungus in order to disentangle the various forms or strains. It causes a widespread disease of blight and canker similar to cedar blight. Inoculation experiments were undertaken on a large number of hosts on many species of juniper and also on other conifers. It was found that there are two strains which differ in cultural characters. The paper deals only with the strains known to be definitely *Phomopsis juniperovora*. The effect produced by the disease and its occurrence are fully discussed.

A. L. S.

Diaporthe perniciosa as a Disease of Lilac.—F. C. DEIGHTON ("On the Occurrence of *Diaporthe perniciosa* or a closely related form on Lilac," *Trans. Brit. Mycol. Soc.*, 1927, **12**, 70–73). The fungus in question was constantly found on the dead branches of lilac during an investigation of lilac trees at Cambridge. Inoculation experiments on healthy lilacs were not successful. The fungus was isolated from the affected branches, and it is considered likely that, under unfavourable conditions, such as dense shade, the trees may be liable to attack. Notes are also given on the formation by the tree of gum as a barrier against the fungus. It was found such a formation in lilac was not so effective as in plum or peach, as demonstrated by other workers. A. L. S.

Parasitism of Fusarium.—W. C. BROADFORT ("Studies on the Parasitism of *Fusarium Lini* Bolley," *Phytopathology*, 1926, **16**, 951–78). The study was undertaken as a contribution to the flax-wilt problem. As a result of cultures nine physiologic forms of the fungus were determined which differed in virulence as disease producers. They were tested on different varieties of flax. The writer records all data of spore sizes and appearance in culture with temperature and composition of the culture media. A. L. S.

Study of Plowrightia Ribesia.—ISMÉ A. HOGGAN ("The Parasitism of *Plowrightia Ribesia* on the Currant," *Trans. Brit. Mycol. Soc.*, 1917, **12**, 27–44, 4 pls. 2 text-figs.). The author presents here a study of the pathological aspects of this fungus, long known as causing a disease of the currant. After a historical sketch of work on the subject a section is devoted to field observations—the appearance of the diseased branches. She found that diseased twigs, when affected, were shrivelled and bore fructification of the fungus. Certainly in some cases the fungus had entered by the cut surface (in pruning) and was working back towards the base of the spur. Normal healthy branches are not susceptible to infection. The control measure recommended is to prune back diseased twigs to the surface of the parent branch or stem and to cut out and destroy all infected branches. As regards histology, the penetrating hyphæ are very stout when mature and brown in colour; they invade all tissues within the bark, especially the phloem and pith. Cork layers were formed by the host at the junction of diseased and healthy tissue. Inoculation and culture experiments are fully described and, finally, spore liberation and the mechanism of the ascus which ruptures at the tip on the addition of moisture. In nature spores are discharged only after rain. A. L. S.

Hibiscus Disease.—CARL HARTLEY ("Notes on *Hibiscus* Diseases in Java," *Phytopathology*, 1927, **17**, 25–7). The notes deal with *Hibiscus cannabinus*, a member of the Malvaceæ. *Sclerotium Rolfsii* frequently occurred on it in the neighbourhood of Buitenzorg, and the plants suffered also from a slime disease caused by *Bacterium solanacearum*. Another species of *Hibiscus* was attacked by a *Phoma* on the leaves. The disease and the experiments undertaken are described; inoculation experiments were successful. A. L. S.

Gooseberry Mildew Control.—R. M. NATTRASS ("Further Experiments on the Control of American Gooseberry Mildew," *Journ. Ministry Agric.*, 1927, **33**, 1017–22). A large measure of control of the disease due to the mildew fungus had been achieved by spraying experiments in the Bristol province in 1925. These were renewed in 1926 and several points were emphasized. It was found, for instance, that an early application of the spray fluid before any sign of infection was most efficacious. It checks the spread from areas early infected by the

winter fruiting bodies of the fungus lying on or near the ground. This early spray of Burgundy mixture (copper sulphate and soda) was more effective than a double spray of ammonium sulphide solution. On another plot results were not so favourable, but the situation was exceptionally favourable for the spread of the disease. But even there the yield was very much greater on the sprayed bushes than on the non-sprayed.

A. L. S.

Notes on *Nectria Rubi*.—I.—G. H. PETHYBRIDGE (*Trans. Brit. Mycol. Soc.*, 1927, 12, 20–3). This fungus has been frequently found on raspberry canes and has been the subject of various investigations. Pethybridge found, in Ireland, perithecia on several parts of a raspberry, the roots of which were diseased. No perithecia were present on the roots, but when these were kept moist *Fusarium* appeared, which was determined as a stage of the *Nectria*. Inoculation experiments failed. The same fungus is reported from Scotland.

II.—R. M. NATTRASS. (Op. cit., 23–7). The writer reports observations on the same fungus in the West of England, and a somewhat similar research was carried out by him, with practically the same results. Other fungi were present, and the connection of the diseased condition with *Nectria Rubi* has not yet been satisfactorily proved.

A. L. S.

Disease of Apples.—W. A. R. DILLON-WESTON ("Notes on the Canker Fungus (*Nectria galligena* Bres.)," *Trans. Brit. Mycol. Soc.* 1927, 12, 5–12, 3 pls.). The writer found the perithecia of *Nectria galligena* the "canker fungus" of apples on shrivelled fruits of Worcester Pearmain in March. The trees had been moderately attacked by canker; the conidial stage is *Fusarium Wilkommii*, which causes the disease stage known as "eye-rot." Cultures of the fungus were made and twigs were successfully infected. A case of pear canker due to the same fungus was also investigated. Spraying experiments are described.

A. L. S.

Hop Mildew.—E. S. SALMON and W. M. WARE ("The Downy Mildew of the Hop in 1926," *Journ. Ministry Agric.*, 1927, 33, 1108–21). The authors have given a long account of the prevalence of this disease due to the fungus, *Pseudo-peronospora Humuli*. It has continued to spread in recent years on the Continent—in Germany, France, Czecho-Slovakia, Jugoslavia and Belgium—as well as in England. In 1926 outbreaks of the disease occurred in a number of hop gardens in Kent and adjoining counties. In a few cases the hops were so damaged in colour that they were not picked. The fungus produces spores throughout the growing season on leaves, surface of shoots, and on cones. Winter spores (*oospores*) are formed in the tissues of the leaves, in the stems of "spiked" shoots, and in the petals of the hop cone. In cases where the spiked growths (due to the disease) were removed from the hop garden, the spread of the disease to the cones was prevented. Lateral shoots below the spiked tips are usually healthy and may safely be trained up. It was found also that the mycelium may be present in the root-stock. Advice is given as to the destruction of diseased bines, cones, etc.

A. L. S.

***Fusarium Lini*.**—HOUSTON LETCHER and J. J. WILLAMAN ("Biochemistry of Plant Diseases VIII, Alcoholic Fermentation of *Fusarium Lini*," *Phytopathology*, 1926, 16, 941–9, 3 text-figs.). *Fusarium Lini* is the fungus that causes flax-wilt. Experiments were made by culturing the fungus on saccharine media; six different kinds were used, and ethyl alcohol was produced in all of them. It was found that the forms of the fungus least virulent in their attack on the flax had the lowest production of alcohol.

A. L. S.

Lichens.

Structure of *Peltigera* with Especial Reference to *P. praetextata*.—O. V. DARBISHIRE (*Ann. Bot.*, 1926, 40, 727–58, 4 pls.). The author gives details of his methods of laboratory preparations. He then gives an account of the structure of the metathallus of this and other *Peltigerae*. The two symbionts—*Nostoc* alga and lichen fungus—are present from the earliest stage. Growth at the margin takes place by the horizontal development of the hyphæ immediately below the gonidial zone, the meristematic tissue; some of the hyphæ help to form the tomentum by which the young margin is covered. A description of the rhizines follows, and an account of their development and function—attachment and water conduction. Extensive anastomosing takes place in the rhizine and gives strength. Isidia are small outgrowths from the upper surface of the mature lichen thallus, rising from the ordinary gonidial layer, and it is the fungal hyphæ that lead the way by pushing through the cortex; or isidia may arise where a crack in the thallus has taken place, in the latter case the hyphæ grow out to protect the exposed gonidia. As the isidium develops there are formed the different tissues of the thallus, the under side is only one cell thick, and is interrupted by occasional minute openings or pores of regular oval shape, which evidently function as organs of gaseous exchange and are important for photosynthesis. These isidia are not primarily reproductive in function but of value in the extension of photosynthesis. Views as to the origin of lichens are discussed. Darbishire looks on *Peltigera* as a typical land-plant, and considers that its ancestors must have developed as land-plants from the very earliest stages. In support of his views he instances the extensive air-spaces on the under side of the thallus and the pores of the isidium as typical land-structures. An extensive bibliography of papers and books, dealing with the special points dwelt on in the text is appended. A. L. S.

Soredia of *Peltigera erumpens* Wain. and *P. scutata* Kbr.—O. V. DARBISHIRE (*Trans. Brit. Mycol. Soc.*, 1927, 12, 52–70, 2 pls.). The author gives a sketch of work done on soredial formation, and describes fully the formation of these bodies in the above lichens. They arise endogenously by the activity of the meristematic hyphæ of the gonidial layer which push their way upwards and outwards associated with algal cells; they emerge without forming a wound. It has not been possible to determine the origin of the stimulus to soredial formation, nor to decide which of the two symbionts takes the lead. Soredia are reproductive bodies, and, as such, separate easily from the parent plant, thus differing from isidia, which are assimilative bodies and normally remain attached. Darbishire describes the lichen hyphæ as habitual in contrast with the gonidia, which are casual, but as a system, he declares, the lichen form of symbiosis works perfectly. A. L. S.

Water Absorption in Lichens.—K. GOEBEL (“Die Wasseraufnahme der Flechten,” *Ber. Deutsch. Bot. Ges.*, 1926, 44, 158–61). The author instituted this research in Java, where lichens, mainly epiphytic, are abundant. In some non-corticate lichens, such as *Coenogonium* and *Dictyonema*, the thallus may become a sponge full of water. In corticate lichens occasional hyphæ project from the surface and the margin and act as capillary agents. Examples of these are *Erioderma tomentosum* and *Peltigera* spp., the outgrowth from the margins of *Anaptychia* spp., etc. The chief problem is concerned with the closely corticate species. Goebel describes the two types of hyphæ in lichens as air containing hyphæ and thickwalled hyphæ; the latter are easily moistened, and retain water by imbibition in the cell-walls or in the cell itself. Water from the surface of the

thallus penetrates within as has been proved. Thus, thick-walled hyphæ not only serve for strength, as in chondroid conditions, but water travels through the membranes. Structureless gelatinous substances imbibe water still more readily, as in *Collema* spp. Goebel states also that air hyphæ that excrete lichen acids are not easily moistened—removal of the acids proves this—probably a distinct function of acids in hindering the entrance of water. Further work will be published later.

A. L. S.

Amyloid Lichen Hyphæ.—E. BACHMANN ("Hyphæ Amyloides bei einigen Flechten," *Ber. Deutsch. Bot. Ges.*, 1926, **44**, 201-7, 9 text-figs.). Amyloid hyphæ, i.e., hyphæ that give a blue reaction with iodine are characteristic of certain *Lecideæ*, and are of distinct physiological and systematic importance. These lichens are *Lecidia confluens*, *L. subconfluens*, *L. tessellata*, *L. speirea*, *L. pantherina*, *L. subterluescens*, *L. lapicida*, and *L. athrocarpa*. There is one species of *Rhizocarpon*, *R. distinctum*, in which the same reaction occurs. Bachmann has given us a study of the distribution of these amyloid hyphæ; he finds that they occur in the cortex, gonidial zone and medulla. The stain is absent, however, from the hyphæ encircling the gonidia, from the outer and inner layers of the cortex, and from the yellow or brown cells of the fruit walls. Bachmann holds that the hyphæ in these positions have been altered in chemical properties owing to special function. He also suggests that the blue colouring substance of the outer lamellæ may be identical with isolichenin as determined by Ziegenspeck in lichen asci. In *Rhizocarpon distinctum* alone is the whole medulla of hyphæ in the amyloid condition. A. L. S.

Succession in Lichens.—CHARLES C. PLITT (*Bryologist*, 1927, **30**, 1-4). The author touches on the work already done on lichen successions as a section of general ecology; his own observations on lichen growth tallied well with those already recorded. Crustose species form, apparently, the first succession; these in turn are succeeded by foliose species; there is again keen competition between these, the more closely attached species being replaced by the looser forms with ascending margins. Fruticose species may succeed; thus, *Cladonia pycnoclada* replaces *Sticta* sp. *Usnea* may cover a tree trunk to the exclusion of all other species. Plitt considers that the lowly lichens in the story of succession parallel in many ways the successions of the whole vegetable kingdom.

A. L. S.

Lichens of the Isle of Man.—J. W. HARTLEY and J. A. WHELDON (Supplement, *North Western Naturalist*, 1927, **2**, 1-12). The work now being published was prepared by the authors before the lamented death of J. A. Wheldon and is now issued by Hartley. The two authors explored together the districts most suitable for lichen growth, collecting the plants and taking note of the substrata, orientation, moisture, etc. The conditions, with abundance of moisture and sunshine, are very favourable to lichen growth. Inhibitive factors are the high winds and the sea-spray, to which the whole island is subjected. The writers have divided the territory into three floristic areas: (1) The northern area, a fairly level plain of cultivated land occupying about one-sixth of the island; (2) the central area, a hilly or mountainous region of uncultivated ground; the glens, which run from the mountains down to the sea, are densely wooded, but the deep shade is unfavourable to lichen growth; (3) the southern area, a region of hills and glens, but the coast line, which measures about 80 miles, yields the richest lichen flora, the rocks that project above the water at high tides are covered with lichen growth. The maritime flora is constantly contrasted with that described by M. C. Knowles for Howth Island; the stratification of lichen belts is the same, and the more abundant plants are identical; but with the larger area and the more

varied type of rocks, the yield of species is naturally larger for the island. A comparison is also made with the sand-dune flora of Lancashire, which has been thoroughly explored; the two floras differ widely, as the dunes of the island are dryer, with more pebbles and with less of shell lime. Cladoniæ are more abundant, and the pebbles are usually covered with lichen patches. A future paper is promised with the more systematic portion of the work. A. L. S.

Occurrence and Distribution of Lichens in North Finland.—VELI RÄSÄNEN ("Ueber Flechtenslandorte und Flechtenvegetation im Westlichen Nordfinnland," *Helsinki*, 1927, *Suomal. Kirjall.*, etc., Oy 1-190). The author has directed his attention very specially to the position and substratum of definite classes of lichens. He gives a sketch of work done in his country by previous workers, and describes the conditions of topography and of climate; the sunny days, he states, prevail over the sunless. He then proceeds to name the different substrata examined:—Sea-rocks, forest stones, stones in the open meadows, etc., mountain rocks, caves, etc. These are taken up in turn and the lichen vegetation reported. Only a few notes are here possible:—Stones in the open are more densely covered with lichens than in the woods, and owing to their evidently less ancient history they are not yet fully invaded by mosses. In caves he found lichens that in the open were shade lovers; he noted also the frequency of their red or yellow colouring, and contrasts that phenomenon with the red algæ that inhabit deep waters. Cave lichens depend on moisture condensation for their supply of water. Aquatic lichens are more abundant in shallow streams than in rivers. A note on "rusted" lichens points out that such lichens grow on rocks or stones containing crystals of iron pyrites. Räsänen has paragraphs devoted to the lichens of paths and the sides of ditches, but here one notes the absence of Collemaceæ from his lists. Epiphytes have received the same detailed attention, and notes are made of such lichens as grow near the ground or on the branches; the north side of the tree was as a rule the most favourable positions for lichen growth. Räsänen considers that each kind of tree has its peculiar epiphytes, and therefore he has given the epiphytes as he found them on the various trees. A complete bibliography of the special treatment of lichen growth in Northern Europe is given.

A. L. S.

Influence of Hydrogen Ions on the Distribution of Lichens.—EGON TRÜMPENER ("Ueber die Bedeutung der Wasserstoffionenkonzentration für die Verbreitung von Flechten," *Beih. Bot. Centralbl.*, 1926, 42, 3, 321-54). The author has made a research on the amount of influence of the pH values on the growth of certain lichens. He explains his method of testing; he took thin portions of the substratus rock, bark, etc., broke them up and kept them in water for some hours, and then applied the usual test. He found that the base of trees generally was less acid than the higher reaches, and that certain lichens, especially ammoniaphil lichens, grew there by preference. Ammonia he found was the source of the nitrogen required by lichens, and not nitrates or nitrites. Heat and dryness of town areas were as potent in banishing lichens as the presence of soot and gaseous air. The whole subject of nitrophilous lichens is discussed and their relation to different substrata.

A. L. S.

Mycetozoa.

Wild Flora of Zurich Botanical Garden.—HANS SCHINZ ("Beitrag zur Kenntnis der im Botanischen Garten der Universität Zurich, 1905-26, festgestellten Pilze und Moose," *Myxogasteres Vierteljahrsschrift Naturf. Ges. Zurich*, 1926, 71,

179-82). The author records an account of the impulse to describe the wild flora of the gardens given by a similar flora published for Kew Gardens. He gives a list of 12 different genera of Mycetozoa, with 33 species or varieties, with their habitats. Many of them were collected in the hot-houses. A. L. S.

Myxomycetal Misdemeanors.—THOMAS H. MACBRIDE (*Mycologia*, 1927, 19, 32-4). The author somewhat whimsically describes two cases in which Mycetozoa were accused of doing damage to vegetation. In one case *Physarum vernum* grew on a lawn, and the dark-coloured fruits were supposed to be indicative of damage to the pasture. In the other case *Physarum oblonga* had become entangled with young growths of the sweet-potato, *Ipomaea*. Possibly the growing points of the *Ipomaea* were checked or killed, but the condition was not pathologic, it was rather that of securing a foothold by the Mycetozoon. A. L. S.

Mycetozoa from Porto Rico.—ROBERT HAGELSTEIN (*Mycologia*, 1927, 19, 35-7). The species enumerated were collected by the writer during the early months of 1926, about half of them previously unrecorded for that region. The determinations were verified by W. C. Sturgis. Notes are given on some special characteristics of the specimens. There are 23 species recorded. A. L. S.

MICROSCOPY.

Technique.

Microscopical Tests for Certain Naphthalene Sulphonic Acids.—W. GARNER (*J. Soc. Dyers. Cols.*, 1927, 43, 12). Characteristic crystalline metallic salts are given by Schaffer's acid (β -naphthol-6-sulphonic acid), naphthionic acid (α -naphthylamine-4-sulphonic acid), Koch acid (α -naphthol-3:6:8 trisulphonic acid), and 2S acid (1-amino-8-naphthol 2:4 disulphonic acid) with zinc, manganese, nickel, magnesium copper and iron compounds. S acid, H acid, and J acid gave no useful results. The procedure adopted was to add 3-4 drops of the concentrated solution of the acid, or its sodium salt, to 2 drops of 40 p.c. solution of metallic salt in a plasticine cell $\frac{1}{2}$ in. diameter, built on a microscopic slide, and the mixture allowed to evaporate slowly. The main characteristics of the crystals produced from the above compounds are tabulated. A. H.

NOTICES OF NEW BOOKS.

Lens Computing by Trigonometrical Trace.—By Col. Gifford, F.R.A.S. With a foreword by Prof. Cheshire, C.B.E. 1927. xii + 81 pp., 18 figs. Published by Macmillan & Co., Ltd., St. Martin's Street, London, W.C. 2. Price 7s. 6d. net.

The Zeiss Works and the Carl Zeiss Foundation in Jena.—By Prof. Felix Auerbach, with a foreword by Prof. Cheshire, C.B.E. 1926. 273 pp., 253 figs. and 1 plate. Published by W. & G. Foyle, Ltd., Charing Cross Road, London, W.C. 2.

Les Mitoses de la Granulosa Atresique dans L'Ovaire de la Lapine.—By A. L. Salazar. 1923. 162 pp., 22 plates. Published by Tipografia "Porto Medico," Lda., 12 A, Praca da Batalha, Porto. Price 20 fr.

Études sur les Maladies et les Parasites du Cacaoyer et D'Autres Plantes Cultivées à S. Thomé.—By A. F. De Seabra. 1922. iv + 122 pp., 65 figs. and 4 plates. Published by Imprimerie de la Librairie Ferin, Lisbon. Price 10 fr.

Norwegian Mountain Algæ.—By K. Munster Strom. 1926. 263 pp. and 25 plates. Published by 1 Kommosjon Hos Jacob Dybwad, Oslo.

The Composition and Distribution of the Protozoan Fauna of the Soil.—By H. Sandon, M.A. 1927. xvi + 230 pp., 6 plates and 3 charts. Published by Oliver & Boyd, Tweeddale Court, Edinburgh. Price 15s.

Illinois Biological Monographs. Some North American Fish Trematodes.—By Harold Winfred Manter. 1926. 138 pp., 6 plates. Published by the University of Illinois. Price \$1.50.

Catalogue of Cainozoic Plants in the Department of Geology. (Vol. I. The Bembridge Flora.) By Eleanor Mary Reid, B.Sc., F.L.S., F.G.S., and Marjorie Elizabeth Jane Chandler. With a section of the Charophyta, by James Groves, F.L.S. viii + 206 pp., 12 pls. 1926. Published by The British Museum (Natural History), Cromwell Road, London, S.W.7.

Index Animalium. By Carolo Davies Sherborn. Part X., pp. 2249–2568. Part XI., pp. 2569–2880. 1926. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 10s. each part.

The British Hydracarina. By Chas. D. Soar, F.L.S., F.R.M.S., and W. Williamson, F.R.S.E., F.L.S., F.R.M.S., 1927. Vol. II. viii + 215 and 20 pls. Published for the Ray Society by Dulau & Co., Ltd., 34 Margaret Street, Cavendish Square, London, W.1.

The British Charophyta. By James Groves, F.L.S., and George Russell Bullock-Webster, M.A., F.L.S., F.R.M.S. 1924. Vol. II. Chæræ. xi + 129 pp., 6 text-figs. and 25 pls. Published by the Ray Society.

The External Morphology and Bionomics of the Commonest Indian (Tick Hyalomma ægyptium). By Mohammed Sharif, M.Sc., F.R.M.S. 1924. 25 pp., 5 pls. Published by the Agricultural Research Institute, Pusa, India. Bulletin No. 152. 1924. Price Re. 1.

The Science Reports of the Tohoku Imperial University. Biology, Vol. I., No. 1, August 1924. 95 pp., 12 text-figs. and 2 pls. Published by the Tohoku Imperial University, Sendai, Japan. Issued temporarily by the Wistar Institute of Anatomy and Biology, Philadelphia, Pa., U.S.A. Price 2 yen.

Dengue. Its History, Epidemiology, Mechanism of Transmission, Etiology, Clinical Manifestations, Immunity, and Prevention. By J. F. Siler, Milton W. Hall and A. Parker Hitchens.

These are the first two numbers (January and February, 1926) of Volume 29, Philippine Journal of Science, issued as one and comprising pp. 1-304, with eight plates. The monograph is devoted to a discussion of experiments and observations on dengue fever and certain aspects of the question which suggested its relationship to yellow fever. Although not entirely or even mainly microscopical in its objects and aims, it presents a very complete summary of experimental work on dengue, which leads the authors to conclude that dengue and yellow fever are transmitted by the same species of mosquito (*Aedes aegypti*), and the mechanism of transmission for both diseases is strikingly similar. That is to say, the dengue patient infects mosquitoes during the first three days of his illness; the infected mosquito is unable to transmit the virus until eleven days after its infection—then remains infective throughout the remainder of its life; hereditary transmission of the virus does not occur. Epidemics of both dengue and yellow fever are subject to the same control measures which involve a material reduction in the mosquito population of the community. A very full bibliography is appended.

The Composition and Distribution of the Protozoan Fauna of the Soil.

—By H. Sandon. Biological Monographs and Manuals. No. VII. 1927. (Oliver and Boyd: London and Edinburgh.) pp. xiii + 237, 5 pls., 3 charts. Price 15/- net.

Mr. Sandon has done a useful service in bringing together all the available records regarding the composition and distribution of the protozoan fauna of the soil. The protozoology of the soil is a comparatively new, and hence little known, branch, and this work provides the first introduction to the subject. About one-third of the book is devoted to the distribution of the protozoa in various soils from different parts of the world. The influence of climate, type of soil, and other conditions upon the incidence of protozoa is discussed, and shown in a number of tables and charts. "All the soil protozoa appear to be world-wide in their distribution. . . . It has not been found possible to associate characteristic species with any particular geographical areas or soil types." The remaining two-thirds of the work is devoted to a systematic account of the protozoa themselves. Each genus and species is briefly characterized, and its distribution is indicated. The classification adopted is on the whole conventional, though in the case of the Mastigophora the author follows the botanical system. The keys to the genera and species of the three classes described, together with the diagnosis, provide a practical guide for the determination of the organisms, but it may be urged, however, that a dichotomous arrangement of the keys would probably serve this purpose better than the somewhat unusual and inconvenient form used here. There are six plates, the figures in three of which are reproduced from other sources. The bibliographical list contains 127 references, and there is a subject index.

C. A. H.

PROCEEDINGS OF THE SOCIETY.

CONFERENCE AT LIVERPOOL.

MARCH 29th, 30th AND 31st, 1927.

Tuesday, March 29th, 1927.

The Lord Mayor of Liverpool (the Rt. Hon. F. C. Bowring, J.P.) and the **Lady Mayoress**, held a Reception at the Town Hall to welcome the Delegates and Fellows of the Society.

The Conference and the Exhibition were officially opened in the evening by Mr. Hugh R. Rathbone, M.A., LL.D. (Pro-Chancellor).

A MEETING

OF THE SOCIETY WAS HELD IN THE HARTLEY BOTANICAL THEATRE OF THE UNIVERSITY OF LIVERPOOL, ON WEDNESDAY, MARCH 30TH, 1927, DR. JAMES A. MURRAY, PRESIDENT OF THE SOCIETY, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The nomination papers were read of five Candidates for Fellowship.

New Fellows.—The following were elected as Ordinary Fellows of the Society :—

James Haslam, M.B., Ch.B., Bolton.
 Frederick H. Lewis, I.S.O., Reigate.
 Eric Ponder, M.D., D.Sc., F.R.S.E., Edinburgh.
 Archibald Parker Welch, Goodmayes.

The Deaths were reported of :—

Dr. C. Da Fano. Elected 1920.
 Mr. A. Bolles Lee. Elected Hon. Fellow, 1897.
 Dr. F. Shillington Scales. Elected 1898.
 Mr. John Stuart. Elected 1871.

A vote of sympathy with the relatives was passed.

THE FIRST SESSION OF THE CONFERENCE

WAS HELD IN THE HARTLEY BOTANICAL THEATRE, BROWNLOW STREET, LIVERPOOL,
ON WEDNESDAY, MARCH 30TH.

The following papers were read and discussed :—

Mrs. Bisbee, M.Sc.—

“ A Method for Demonstrating Certain Features in the Anatomy of Flat Worms.”

Mr. J. Ross-Mackenzie, F.C.S., F.R.M.S.—

“ Causes and Correction of Cloudiness in Malted Liquors.”

Dr. W. E. Cooke, M.D., F.R.C.P., M.R.C.S., F.R.M.S., and Mr. C. F. Hill, F.R.M.S.—

“ Pneumokoniosis due to Asbestos Dust.”

Mr. R. J. Daniel, M.Sc.—

“ Note on a Method of Staining and Clearing Muscular Systems of Crustacea.”

Mr. H. E. Hurrell, F.R.M.S.—

“ The Ecology of Fresh-Water Polyzoa in East Anglia.”

Professor J. Bronté Gatenby, B.A., Ph.D., D.Sc., F.R.M.S.—

“ Golgi Apparatus, and Idiozome: a Critique of Parat's Vacuome Theory.”

Professor R. Ruggles Gates, M.A., Ph.D., F.L.S., F.R.M.S., and Dr. J. Latter, Ph.D.—

“ Meiotic Phenomena in *Lathræa*.”

Dr. R. J. Ludford, Ph.D., D.Sc., F.R.M.S.—

“ The Cytology of Secretions.”

Votes of thanks were accorded to the authors of the foregoing papers.

In the afternoon, on the invitation of the Directors, the Fellows and Delegates visited the Match Factory of Messrs. Bryant and May, Ltd., and were hospitably entertained. The Directors were cordially thanked for their invitation.

In the evening a Reception and Conversazione in the Departments of Geology, Zoology and Botany, was given to Fellows and Delegates by the University Authorities. The Visitors were received by the Pro-Chancellor, Mr. H. Wade Deacon, C.B.E.

THE SECOND SESSION OF THE CONFERENCE

WAS HELD IN THE HARTLEY BOTANICAL THEATRE, BROWNLOW STREET, LIVERPOOL,
ON THURSDAY, MARCH 31, DR. JAMES A. MURRAY, PRESIDENT, IN THE
CHAIR.

The following papers were read and discussed :—

Dr. A. C. Thaysen and Mr. H. J. Bunker.—

“ Some Observations on the Microscopical Study of Deteriorated Fabrics from Early Egyptian Tombs.”

Professor C. O. Bannister, M.Inst.M.M., F.I.C.—

“Demonstration of the Use of the Microscope in the Examination of Surface Structure of Metals and in the Detection of the various Platinum Metals in Silver Beads.”

Professor W. Ramsden, M.A., M.D., B.Ch.—

“Demonstration on Surface Tension.”

Mr. I. S. Double, M.Sc., F.G.S.—

“The Microscopic Characters of Certain Horizons of the British Chalk.”

Dr. Eric Ponder, M.D., D.Sc., F.R.S.E.—

“The Diameter of the Red Cells of Man before and after Exercise.”

Dr. James A. Murray, M.D., F.R.S., P.R.M.S.—

“Experiments in Stereo-Photomicrography.”

Mr. Harold Wrighton, B.Met., F.R.M.S.—

“The Photomicrography of Metals.”

Mr. Conrad Beck, C.B.E., F.R.M.S.—

“The Best Method of Illumination of Metallurgical Specimens with Vertical Illuminator.”

Hearty votes of thanks were accorded to the authors of the above papers.

In the afternoon the Fellows and Delegates visited the Gladstone Dock (by invitation of the Mersey Dock and Harbour Board).

In the evening a Popular Lantern Lecture was given in the Arts Theatre at the University on “The Microscopy of Every-Day Life,” by Professor J. Arthur Thomson, M.A., LL.D., F.R.M.S., Dr. James A. Murray, M.D., F.R.S., P.R.M.S., President, in the Chair.

Professor Thomson was enthusiastically thanked for his Lecture.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY, APRIL 20TH, 1927, DR. JAMES A. MURRAY, M.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination paper was read of Mr. Kenneth James Funnell.

New Fellows.—The following were elected Ordinary Fellows of the Society:—

Joseph Arthur Coultas.
R. H. G. Hector Denham.
Charles H. Edger Graham.
James Lomax.
Stanley Victor Risley.

Donations were reported from:—

British Museum—

“The Bembridge Flora.” (Reid and Chandler.)

“Index Animalium,” Parts X and XI. (Sherborn.)

Dr. M. Sanchez y Sanchez—

“Curso Practico de Biologia.”

Messrs. Oliver & Boyd—

“Composition and Distribution of the Protozoan Fauna of the Soil.”

Votes of thanks were accorded to the donors.

The Treasurer presented the Balance Sheet and Financial Report for the year 1926.

FINANCIAL REPORT FOR THE YEAR 1926.

The Income and Expenditure Account for the year shows a balance of Income over Expenditure of £268 6s. 1d.

This amount, added to the credit balance of £106 10s. 5d. brought forward, leaves a balance of £374 16s. 6d. to the credit of Accumulated Income and Expenditure Account.

There is no change in the Life Membership Account, which stands at £1,884 10s.

Sales of surplus books and periodicals from the Library realised £129, and this amount has been credited to Capital Account, with the proviso that the interest on the amount shall be spent on the upkeep of the Library. This year the sum of £29 has been spent on the Library, a good deal of which is for arrears of binding.

Compared with a year ago, the income of the Society shows a further decrease. This is due to the decreased admission fees, but the expenditure shows a decrease of some £290, mainly owing to the decrease in the net cost of the Journal, which, at £32, is the lowest cost in the history of the Society. It should be noted, however, that the Journal contains 20 p.c. less pages than the year 1925, and this year, with the change in form, the cost will be gradually increased.

The Society's securities standing in the Balance Sheet at £1,772 had a market valuation on 31st December, 1926, of £2,243.

The number of Fellows on the Roll of the Society on 31st December, 1926, was 539, a decrease of 7 compared with same date 1925, made up as follows:—

Number of Fellows on the Roll of the Society			
at 31st December, 1925	.	.	546
Ordinary Fellows elected during year	.	.	28
		—	574
Resigned or removed during year	.	.	25
Deceased during year	.	.	10
			35
At 31st December, 1926	.	.	539
This total is made up of:—			
(a) Ordinary Fellows	.	.	492
(b) Life Fellows	.	.	32
(c) Honorary Fellows	.	.	15
		—	539

NOTE.—This does not include 11 members whose resignations were notified in 1925 to take effect in 1926, as a special adjustment was made in respect thereof in the membership statement submitted at 31st December, 1925.

Dr.

INCOME AND EXPENDITURE ACCOUNT

Dec. 31, 1923.				£	s.	d.	£	s.	d.
165	16	0	To Rent and Insurance				163	16	0
403	18	1	„ Salaries and Reporting				430	0	10
			„ Sundry Expenses—						
			Library Books and Binding			28	19	5	
			Stationery and Printing			88	16	2	
			Postages and Petty Expenses			45	12	6	
171	8	8	Refreshments at Meetings			6	19	11	
									170 8 0
			„ Journal—						
			Expenditure—	£	s.	d.			
			Printing	559	18	7			
			Editing and Abstracting	37	8	0			
			Illustrating	49	10	2			
			Postages	22	1	6			
							668	18	3
			Less Receipts—						
			Sales	500	12	1			
			Advertisements	135	19	4			
246	14	0					636	11	5
									32 6 10
102	2	0	„ Sheffield Conference				—	—	—
—	—	—	„ Balance being Excess of Income over Ex-						
			penditure				268	6	1
£1089	18	9					£1064	17	9

Dr.

BALANCE SHEET AS AT

LIABILITIES.

LIABILITIES.		£	s.	d.	£	s.	d.
I. Capital—							
Being (a)	Life Compounded Subscriptions received from 1st January, 1877, to 31st December, 1926	1884	10	0			
(b)	Quekett Memorial Fund	100	0	0			
(c)	Amounts received in respect of sales of Books from the Library (surplus to the Society's requirements)	129	0	0			
					2113	10	0
II. Loan Account							
Note.—The Hon. Treasurer of the Society has advanced this sum and has undertaken to advance any additional sums that may be required to meet the cost of publishing the catalogue of Instruments. The loan is made to the Society free of interest.							
					100	0	0
III. Sundry Creditors—							
	Subscriptions paid in Advance	28	18	5			
	On account of Journal Printing, etc.	162	7	4			
					191	5	9
IV. Income and Expenditure Account—							
Being	Excess of Income over Expenditure as at 31st December, 1925	106	10	5			
Add :	Excess of Income over Expenditure for year to 31st December, 1926	268	6	1			
					374	16	6

£2779 12 3

CYRIL F. HILL,
Hon. Treasurer.

FOR YEAR TO 31st DECEMBER, 1926.

Cr.

Dec. 31, 1925.			£	s.	d.	£	s.	d.
£	s.	d.						
880	6	2	By Subscriptions	.	.	837	0	10
			„ Subscriptions for 1926 unpaid	.	.	52	11	0
								889 11 10
92	8	0	„ Admission Fees	.	.			60 18 0
1	10	6	„ Sundry Sales	.	.			10 9
113	13	11	„ Interest on Investments and Deposit Account	.	.			113 17 2
2	0	2	„ Balance being Excess of Expenditure over Income	.	.			- - -

£1089 18 9

£1064 17 9

31st DECEMBER, 1926.

Cr.

	£	s.	d.	£	s.	d.
ASSETS.						
I. <i>Furniture, Instruments, etc.</i> , as at 31st December, 1925 .				216	13	6
II. <i>Stock of Screw Gauges</i> as at 31st December, 1925 .				2	0	0
III. <i>Investments</i> , as at 31st December, 1925 .				1772	0	0
£400 London & North Eastern Railway Co., 3% Debenture Stock.						
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.						
£915 11s. 4d. India 3% Debenture Stock.						
£150 Metropolitan Water Board "B" Stock.						
£421 1s. 5% War Loan, 1929-47.						
£612 London Midland & Scottish Railway Co., 4% Preference Stock.						
Note.—The Market Valuation of the above Investments at 31st December, 1926, was £2243 4s.						
IV. <i>Catalogue of Instruments</i> —Amounts expended on publication to date .				130	4	5
Note.—The Hon. Treasurer of the Society has given his personal guarantee to meet any part of this expenditure that is not recovered by means of sales of the publication.						
V. <i>Sundry Debtors</i> —						
Subscriptions Unpaid .	52	11	0			
On account of Journal Sales .	171	9	3			
On account of Advertisements .	62	19	1			
Income Tax Recoverable .	10	5	4			
				297	4	8
VI. <i>Suspense Account</i> —Expenses incurred in respect of Liverpool Conference, 1927 .				2	12	6
VII. <i>Cash</i> —						
At Bank—On Current Account .	220	4	9			
„ On Deposit Account .	125	0	0			
In Hand .	13	12	5			
				358	17	2
				£2779	12	3

London, 2nd April, 1927. We have examined the Books and Accounts of the Royal Microscopical Society for the year to 31st December, 1926, and have found the transactions correctly recorded and sufficiently vouched.

In our opinion the foregoing Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library and Stock of Journals (valued for insurance, together with the Furniture, Instruments, etc., at £4,000).

(Signed) THOMSON McLINTOCK & CO.,

Chartered Accountants, Hon. Auditors.

71, Queen Street, E.C. 4.

Mr. Hill moved, and **Dr. MacCartney** seconded :—

“That the Financial Report be received and adopted.”

Carried.

Mr. A. W. Sheppard moved, and **Mr. Oakden** seconded :—

“That a very hearty vote of thanks be accorded to Messrs. Thomson McLintock & Co., Chartered Accountants, for their services as Honorary Auditors to the Society.”

Carried unanimously.

The following papers were read and discussed :—

Dr. G. M. Findlay, M.D., F.R.M.S.—

“The Virus Inclusions of Fowl Pox.”

Dr. James A. Murray, M.D., F.R.S., P.R.M.S.—

“An Endothelioma of the Mouse.”

Votes of thanks were accorded to the authors of the above papers.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT NO. 20 HANOVER SQUARE, W.1, ON WEDNESDAY,
MAY 18TH, 1927, **DR. JAMES A. MURRAY**, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The nomination paper was read of one Candidate for Fellowship.

New Fellow.—**Mr. Kenneth James Funnell** was elected an Ordinary Fellow of the Society.

Donations were reported from :—

Longmans, Green & Co.—

“Plant Autographs and their Revelations.” (Bose.) “Spectroscopy.” (Baly.)

George Routledge & Sons, Ltd.—

“Handbook of Photomicrography.” (Hind and Randles.)

Paul Lechevalier—

“Faune de France.” Diptères (Nematoceres) (Goetghebuer).

Votes of thanks were accorded to the donors.

Exhibits were made by Messrs. R. and J. Beck, Ltd., and the President, who were thanked for the same.

Deaths :—

Mr. Walter Bagshaw. Elected 1909.
 Mr. Walter Dixon. Elected 1896.
 Mr. William Fotheringham. Elected 1917.
 Mr. George Watts. Elected 1919.

A vote of sympathy with their relatives was passed.

The following papers were read and discussed :—

Mr. F. P. Carrel, F.R.M.S.—

“A New Development of the Ultra-Microscope.” (Read by Mr. Barnard.)

Professor R. Ruggles Gates, M.A., Ph.D., F.L.S., F.R.M.S., and Dr. J. Latter, Ph.D.—

“Observations on the Pollen Development of Two Species of *Lathræa*.”

Mr. James Lomax, F.R.M.S.—

“The Preparation and Examination of Coal Sections.”

The following paper was read in title :—

Professor A. G. Hornyold, D.Sc., F.R.M.S.—

“Otoliths of Large Eel from the Rhine.”

Hearty votes of thanks were accorded to the authors of the above papers, and to Mr. Barnard.

The business proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
SEPTEMBER, 1927.

TRANSACTIONS OF THE SOCIETY.

X.—OBSERVATIONS ON THE POLLEN DEVELOPMENT OF TWO
SPECIES OF LATHRÆA.

By PROFESSOR R. RUGGLES GATES, M.A., Ph.D., F.L.S., F.R.M.S., and
J. LATTER, B.Sc., Ph.D.

(Read May 18, 1927.)

SIX PLATES AND ONE TEXT FIGURE.

INTRODUCTION.

AN account of the pollen tetrad wall formation in *Lathræa clandestina* has already been published (Gates 1925). Previously a cytological study of the pollen development in that species had been begun, but owing to lack of opportunity the work did not attain completion. The present paper is the result of the continued and completed study of the pollen development in *L. clandestina*, together with that of the British species, *L. squamaria*, up to the formation of the microspore nuclei.

The genus *Lathræa* consists of five species, all of parasitic habit. The French species, *L. clandestina*, has been introduced from the Continent at the Botanic Gardens at Kew, and in Regent's Park and other places. It is known to flourish on the roots of elm, beech, willow, hawthorn, lilac, holly, privet and *Euonymus*, while *L. squamaria* grows chiefly on the roots of

hazel and beech. Three years ago the capsules were found to discharge their seeds forcibly, the seeds being hurled in one case as much as 27 feet.



FIG. 1.—*L. clandestina* growing on the roots of *Euonymus* in Regent's Park Botanical Gardens.

The appearance of *L. clandestina* as it grows in Regent's Park on the roots of *Euonymus* is shown in fig. 1.

MATERIAL AND METHODS.

The *L. clandestina* material studied was collected from Regent's Park Gardens by Miss E. M. Rees in 1920, and Dr. N. Ferguson in 1924, the fixing fluids being strong Flemming, Merkel, Allen's modified Bouin, and chrome-acetic solutions made up as follows:—(a) Chromic acid 1 gm., Glacial acetic 1 c.c., Water 100 c.c.; (b) Chromic acid 2 gms., Glacial acetic 3 c.c., Water 300 c.c. The *L. squamaria* material was obtained from a hazel copse near Byfleet, Surrey, by Dr. J. Latter in 1924, Allen's modification of Bouin's fluid, and chrome-acetic solution (b) being used. For aid in collecting this material we are indebted to Lady Davy of Byfleet.

The material is by no means an easy one in which to obtain constant excellent fixation. Great variation is observed even in material of the same collection and similar subsequent treatment. The best results were given by Allen's Bouin and chrome-acetic solution (a).

Sections were cut at a thickness of 8, 10 or 12 μ , and the large majority

of preparations stained with Heidenhain's iron-alum hæmatoxylin. Satisfactory results were also obtained by staining with gentian violet and the rapid iron hæmatoxylin method described by Cole (1926).

DESCRIPTION OF NUCLEAR EVENTS.

The pollen development of *Lathræa clandestina* and *L. squamaria* is very similar at all stages, and consequently the following account is applicable to both species. The chromosome number in each is determined as twenty-one haploid, forty-two diploid, and no variation from these numbers has been observed. It is possible that these numbers represent a hexaploid condition, seven being a basic number of frequent occurrence in plant forms of various systematic positions. No other chromosome numbers have been recorded in the Orobanchaceæ. In Scrophulariaceæ, a nearly allied family, the fundamental chromosome number is eight.

PRESYNZESIS.

Occasional binucleate cells are present in the archesporial tissue (fig. 4). These are of rare occurrence, and their further development is at present unknown. Examination of the pollen mother-cells whose nuclei are entering synapsis reveals the apparently constant uninucleate condition of these cells, which fact indicates either the breakdown of the binucleate archesporial cells, or an abnormal formation of cell walls at the last premeiotic division. If, however, the binucleate condition persists and gives rise to later divisions, it must be concluded that such cells are too rare in occurrence to be revealed in later stages by the large quantity of material examined.

The uninucleate resting pollen mother-cells, which are distinctly polygonal in outline (fig. 5), show the nucleus containing a large spherical deep-staining nucleolus. From this, one or rarely more faintly-stained papillæ project, while within it vacuoles and dark crystal-like bodies are seen. The periphery of the nucleolus appears in this and many stages to colour more deeply than the central portion. This may in part be due to optical effect. The reticulum, which is granular in appearance, is mainly aggregated at the periphery of the nucleus, from which faintly-staining and granular strands reach out across the nuclear cavity and apparently connect with the nucleolus.

At the onset of synapsis, the granular appearance of the reticulum is lost, and a very delicate thread-like structure revealed. Held in the meshes of the reticulum are dense aggregations of chromatin (fig. 6), the appearance of which is the first indication of approaching synapsis. These homogeneous masses are in no way comparable with the prochromosomes of other authors, for they bear no relation to the later formed chromosomes either in number or position. They definitely form part of the threads themselves, and are included in the synzetic knot as contraction proceeds. Similar bodies have been recorded (Gates 1908) in the presynzetic nucleus of *Oenothera rubrinervis*,

but there is some doubt as to whether these form part of the contracting reticulum, or are merely inclusions in its coils. Chromatic aggregations are also found in the resting nuclei of the tapetal, archesporial and tetrad cells of *Crepis virens* (Digby 1914), and are definitely stated not to be true prochromosomes.

SYNZESIS AND SYNAPSIS.

When contraction of the reticulum has reached its height, the synizetic knot is extremely condensed (figs. 7, 8, 9, 10), and the thread-like nature of its contents impossible to discern. Large masses of densely-staining homogeneous substance are present in the knot, doubtless resulting from the union of the presynizetic chromatic aggregations. There is no indication of a precipitation membrane around the contracted reticulum as described by Gates and Rees (1921) in *Lactuca*, and generally the synizetic knot is of irregular outline. Minor differences occur at this stage between the two species studied. The nucleolus of *L. clandestina* displays constantly a single pale-staining papilla, and situated near this are one or two small spherical vacuoles. The appearance of a papilla in *L. squamaria* is not constant, and the number and position of the vacuoles is more variable. It cannot be definitely stated that the nucleolar papilla is absent from the species, as the synizetic knot, which in both species is in extremely close contact with the nucleolus, may be obscuring it from view. Neither species gives evidence of any connection between the papilla and the contracted reticulum.

At the termination of synizesis, the close contact between nucleolus and contracted reticulum is ended, and a definite connection between the two is established at their point of contact (fig. 11). In the nucleus figured, two irregularly shaped dark bodies are seen in the nucleolus, and to them the reticulum is attached. These structures will be referred to as the "nucleolar bodies," and a comparison between these and similar nucleolar inclusions described in other forms will be given in the discussion at the end of this paper.

At the initiation of the late synaptic stages the change from the granular appearance of the reticulum to that of a well-defined thread is very marked (fig. 12). As the knot loosens out, it is clearly seen that the chromatin is unevenly distributed along the threadwork, and also that the latter remains in constant connection with the nucleolus. Figs. 12 and 13 are deeply stained in order to get clear definition of the thread and consequently the nucleolar bodies are not in evidence. When every trace of the synizetic knot has disappeared the branched loops of thread all lie on one side of the nucleolus, apparently radiating out from it (fig. 13). Those portions of thread in direct contact with the nucleolus display heavy chromatin thickening in contrast with the finer thread of the more remote parts. This condition suggests a transference of substance from the nucleolus, and its utilisation during thread formation, the near threads being much thickened by the exuded material. Similar much-swollen threads in contact with the nucleoli are recorded and figured in various species of *Oenothera*. Cleland (1922)

attributes this condition to the outflowing of nucleolar material on to the spireme and its ultimate incorporation in the chromosomes (6, 7, 8, 9). It is of interest to note that Cleland also describes or figures an endonucleolus in these same forms, this possibly being comparable with the nucleolar bodies of *Lathræa*.

The nuclear conditions shown in fig. 13 may at first sight suggest a comparison with the brochonema or looping stage of *Lathyrus* (Latter (1926)). A critical examination of the thread, however, reveals an important distinction. It is not composed of separate loops lying free from one another, but is still a continuous reticulum. The fact, however, that those portions of the thread which radiate from the nucleolus tend to be thicker and more deeply-staining than the rest, gives a superficial resemblance to the brochonema stage of free radiating loops. This reticulate condition of a postsynizetic thread is one not previously recorded in plant cytology. Problems of varying interest and importance which this type of spireme suggests are put forward in the discussion at the end of this paper.

At a slightly later stage in the nuclear development, the thread becomes more evenly distributed throughout the nuclear cavity, and the chromatin thickening is nearly uniform over the reticulum. These features, together with the attachment to the nucleolus by three or more nucleolar bodies, are shown in fig. 14.

The nucleolus remains approximately spherical throughout all the prophase stages, never assuming a crescent shape against the nuclear membrane. The significance of the shape of the nucleolus during heterotypic prophase is not yet understood. In plants, the flattened type of nucleolus has been figured in *Lilium*, *Galtonia*, *Oenothera*, *Chrysanthemum*, *Lathyrus* and *Ranunculus*, and in animal literature has been shown to occur in *Blattella*, *Aphids*, *Euschistus*, *Patella* and *Drosophila*.

The nucleus has now attained its maximum size, being, on an average, $14.5\ \mu$ along its greatest diameter.

Figs. 15, 16, 17, 18, 19, 48, 49, 50 are taken from more faintly-stained preparations in which dark nucleolar bodies are clearly seen forming points of attachment of the reticulum to the vacuolate nucleoli. The nucleolar bodies are usually situated peripherally and display great variability in size. A comparison of fig. 17 with others in which the attachment to nucleolar bodies is shown suggests that the nucleolus drawn in fig. 17 is, perhaps, at a slightly earlier stage—i.e. that the dark-staining substance is being transferred to the thread work, and in this case the transference has not been carried so far as in the other nuclei figured. Conclusive evidence on this point could not be obtained, though, on comparison with fig. 11, it seems more probable that the smaller size of nucleolar body is primarily differentiated at the first indication of the loosening of the synizetic knot, while the larger ones seen occasionally in the late synaptic stages are probably extremes in size variation and not growth stages.

Occasionally nucleoli are observed in which the proportions of light and

dark stained substance are approximately equal, but the line of demarcation between the two is not sharp. One area seems gradually shaded off into the other. These cases, however, are too rare to be considered typical, and are probably in some way due to treatment.

The vacuolate condition of the nucleolus during thread formation is a striking feature, and suggests loss of nucleolar material and its utilisation in chromatin formation.

FORMATION OF THE CHROMOSOMES.

The method of chromosome formation in *Lathræa* is typical neither of telosynaptic nor parasynaptic forms. As previously stated, the reticulate structure of the thread is retained through the late synaptic stages, and the first indication of chromosome formation is the appearance of small chromatic beads upon the reticulum, while the thread between these chromatin aggregations becomes very delicate and pale-staining. One loop of the reticulum in fig. 14 shows two distinct breaks in the distribution of the chromatin on the thread, this possibly being an early indication of chromatic bead formation. The chromatin aggregations are irregularly distributed upon the reticulum (fig. 20) and show great variation in size. It is impossible to determine whether any one aggregation represents a future univalent or bivalent chromosome, for unfortunately these stages presented considerable difficulty in the study of the pollen development, partly owing to the rapidity with which chromosome formation takes place and partly owing to the inferior fixation of a considerable amount of the material. The process appears to be a flowing together of the chromatin on the threads, so that it is finally aggregated about certain points, which remain for a time connected by delicate filaments. The connection with the nucleolus is retained throughout this process. Figs. 21 and 22 are taken from cut nuclei in which only part of the reticulum is present. The large chromatic masses appear suspended in the nuclear cavity by the delicate strands of reticulum. As the contraction of the chromatin proceeds, these delicate threads are presumably severed and drawn into the composition of the chromosomes. The reticulum still appears connected to the nucleolus, but the deep-staining character of this structure obscures any nucleolar body which may be present at the point of attachment. From a comparison of the size of these chromatin aggregations with that of the bivalents in diakinesis, it is obvious that contraction of the chromatin is still continuing, and further, it would seem a necessary process for the severance and absorption of the remaining strands of the connecting threads.

DIAKINESIS AND SPINDLE FORMATION.

During diakinesis the twenty-one bivalent chromosomes can usually be clearly distinguished. In the early stages bivalents may be seen connected by delicate strands (fig. 23) which are the unabsorbed remnants of the

reticulum. The connection with the nucleolus is broken during the continued contraction of the chromosomal elements, that shown in fig. 24 being the latest connection observed.

That the method of chromosome pairing eventually falls into line with that of typical telosynapsis is shown by the bivalents in which contraction is not complete (figs. 23, 24, 25). The homologous chromosomes of several pairs can be seen connected end-to-end, and in some cases from their free ends a severed strand projects, indicating incomplete absorption of the reticulum on which they were formed and a possible previous end-to-end association of the forty-two univalent chromosomes.

The appearance of the nuclear membrane varies with the fixation employed, showing up as a dark well-defined line in preparations of material fixed in chrome-acetic solutions (fig. 26), and being far less conspicuous in material treated with Allen's Bouin. The same remark applies to the facility with which the early spindle stages could be identified, and, in passing, it may be mentioned that similar observations were made on the study of spindle formation in *Lathyrus odoratus*. On this account it does not seem probable that much reliance can be placed on observations on spindle formation in material treated with the ordinary fixatives, for the greater definition of spindle fibres in chrome-acetic fluids may be merely artifact.

The observations on spindle formation in *Lathræa* provide no definite evidence as to the intra- or extra-nuclear origin of the fibres. In the multipolar stages (fig. 28) the nuclear membrane can often be seen still intact around the nuclear cavity while scattered groups of fibres extend into the surrounding cytoplasm. This condition obviously suggests that the fibres are derived from the cytoplasm. If, however, the heavily thickened membrane of the diakinetik nucleus is a natural phenomenon, the outer part may possibly break down to give place to the first formed spindle fibres, while the inner part still remains intact. This state of affairs would not, however, necessitate a nuclear origin of the fibres, for it is not known how the thickening of the diakinetik membrane takes place, whether by deposition of substances from the nucleus, the cytoplasm, or both. It appears that special technique is necessary for the elucidation of these problems.

During diakinesis and the period of spindle formation the behaviour of the nucleolus is variable. Usually a large spherical darkly-staining nucleolus remains until the multipolar phase; in other cases fragmentation may occur into three or more smaller structures.

HETEROTYPIC DIVISION.

On the establishment of the tripolar spindle the twenty-one bivalents have a scattered distribution over the spindle area, and the nucleolus is represented only by a few fragments in the cytoplasm. The dissolution of the nucleolus obviously takes place very rapidly, for in cases in which both diakinetik

and early metaphase cells are present in the same locus a large deep staining nucleolus will be contained in a nucleus in the former condition, and only the slightest trace of such a structure revealed in an adjacent cell in early metaphase. When the bipolar spindle is formed, the bivalent chromosomes are densely grouped on the equatorial plate, usually in very regular formation (fig. 30). A clear area in the cytoplasm is often present around the spindle at this stage, but does not remain in evidence for long.

In the heterotypic anaphase, occasional "lagging" chromosomes are observed (fig. 32). These are of rare occurrence, and appear always to be incorporated later in the daughter nuclei. Fig. 33 clearly shows equal distribution of twenty-one univalents to each pole. Figs. 34 and 35 are taken from preparations of *L. clandestina* and *L. squamaria* respectively, from polar views of the anaphase groups, and together with many other similar chromosome groups determine the presence of twenty-one haploid chromosomes in each species. No indication of the homotypic split is observed on the heterotypic spindle.

At telophase the spindle fibres disappear and are represented by striations in the cytoplasm (fig. 36). The total number of chromosomes at each pole cannot be distinguished in the side view of the telophasic condition.

INTERKINESIS.

Between the two meiotic divisions no resting condition of the nucleus is found. Each daughter nucleus forms a surrounding membrane, one or more nucleoli (fig. 37) and, somewhat later, anastomosing strands between the chromosomes, which latter, however, always retain their identity, but undergo slight temporary enlargement (fig. 38). The X form of chromosome which is frequently assumed during interkinesis in many plants is not very apparent in *Lathræa*, though chromosomes displaying this shape are occasionally found. Absence of this form of chromosome is due to prolonged intimate association of the two halves of each univalent, and not to precocious development of the homotypic split. The remains of the nucleolus of the heterotypic prophase are still evident in the cytoplasm, usually in the form of two globules situated one on either side of the spindle striations between the daughter nuclei. In some preparations the almost constant position of these nucleolar globules is very striking.

HOMOTYPIC DIVISION.

At the initiation of the homotypic division tripolar spindles are observed in addition to the bipolar forms (fig. 39), and on these the twenty-one univalent chromosomes are centrally placed. The chromosomes show no indication of their dual nature during the metaphase, this only being evident after the longitudinal division has occurred, and the anaphase condition is established.

There is great variation in the space relationship of the homotypic spindles, which lie at any angle to one another, showing no preference for any one position. No evidence has been obtained on the method of spindle formation.

During anaphase and early telophase the chromosomes become very compact and closely associated, making recognition of individual units impossible (figs. 40, 41). These compact groups somewhat resemble a sponge or portion of honeycomb (fig. 42), this appearance being due to the close contact and compression of the twenty-one chromosomes and not to true fusion.

Numerous pale-staining globules are scattered in the cytoplasm during telophase, these probably representing the remains of nucleolar material.

At the reconstitution of the grand-daughter nuclei, hyaline areas of the nuclear sap appear amongst the chromosomes, which separate from one another (fig. 43) and eventually lie free in the nuclear cavity round which a delicate membrane is formed (fig. 44). A large nucleolus (rarely two) is present in each nucleus. The origin of this could not be ascertained, but apparently its formation is direct, there being no evidence of previous formation of nucleolar globules and their subsequent coalescence.

The nuclear area shows considerable increase in size, while fine anastomosing strands connect up the chromosomes, which rapidly lose their staining properties and individual identity (fig. 45), till a typical resting reticulum is established.

CYTOMYXIS.

The phenomenon of cytomyxis has been observed at various stages of nuclear activity, especially during the post-synizetic thread stages and diakinesis. This process of transference of chromatin from one mother-cell nucleus into the cytoplasm of an adjacent mother-cell has now been recorded in a variety of plants by different authors, to whose works references are made by Gates and Rees (1921). In addition to its occurrence in the prophase in *Lathræa* it is also observed during interkinesis (fig. 46), and appears not to have been previously recorded at such a late stage in the history of the pollen development of other forms.

An explanation of the late occurrence of this phenomenon may be found in the fact that the pollen mother-cells remain in contact with one another until the final dissolution of their walls at the liberation of the pollen grains (Gates (1925)). The transference of chromatin between two contiguous cells must presumably take place through gaps in the cell walls by means of protoplasmic connections such as those described and figured in *Oenothera gigas* (Gates (1911)). Since the cells remain in contact through all the stages of pollen development, opportunity is afforded for cytomyxis to take place at any stage, and especially so at interkinesis, during which both daughter nuclei are necessarily excentric in the cell.

DEVELOPMENT OF THE TAPETUM.

The tapetal layers are well marked in the late archesporial stages, and from the first display a characteristic condition. The tapetum on the outer wall of the loculus is uninucleate (fig. 2), the layer on the inner wall binucleate, and this condition is maintained throughout the entire process of pollen development until the dissolution of the mother-cell walls. The origin of the binucleate state has not been determined, for in the earliest archesporial stages at which the tapetum can be definitely recognised as such, the cells of the inner layer are already binucleate. The tapetal cells are slightly elongated towards the centre of the loculus, the inner layer consisting of one cell in thickness and the outer occasionally becoming two cells deep. In this latter case the two uninucleate cells occupy approximately the same area as any single cell of the outer layer, and it is possible that this division may in some ways be comparable to that which occasions the binucleate condition of the inner layer. The process of division was not observed in any tapetal cell.

While the pollen mother-cells are entering synizesis, the tapetal nuclei display a pale-staining peripheral reticulate mass connected by well-marked strands to a large deeply stained nucleolus which is often of irregular shape. During synizesis, the peripheral reticulum of the tapetal nuclei gives place to globular chromatic bodies, some of which are usually in connection with the nucleolus. These apparently represent pairs of chromosomes, for their number approximates to twenty-one (fig. 47). The transition from reticulum to "chromosomes" is simultaneous in both inner and outer tapetal layers. In none of the tapetal cells was any further development of the nuclei observed. This persistent stage appears to represent a prophase condition in which bodies corresponding to pairs of chromosomes are formed directly from the reticulum, but no mitosis follows.

At the stage of the dissolution of the pollen tetrad walls, a tapetal plasmodium is produced by the breaking down of the tapetal cell walls. Simultaneously the nuclear membranes of the tapetal cells become less distinct, and the nuclei are somewhat distorted, though no change is apparent in the globular chromatic contents. When the microspores are eventually liberated within the loculus, the tapetal plasmodium encroaches amongst them (fig. 3) and presumably contributes material to the thickening of the pollen grain walls.

A detailed study of the tapetum has not been undertaken, but one or two further observations may be worthy of mention.

Occasional projecting outgrowths of tapetal tissue are seen extending into the loculus, and one record was made of such an outgrowth reaching right across the loculus, dividing it into two parts.

The inner (binucleate) tapetum occasionally shows signs of the occurrence of nuclear fusions. Cells are observed containing one nucleus of abnormally large size, or a "dumb-bell" or "bean" shaped nucleus in which two large

nucleoli are situated. One conspicuously large tapetal cell was seen containing two large nuclei in each of which were situated two nucleoli. This condition suggests not only nuclear fusions, but also abnormal cell division. These irregularities are of rare occurrence, and can only be regarded as slight divergences from the usual maintenance of the binucleate phase throughout.

The tapetum of *Lathræa* differs considerably in its development from that recorded for the majority of plants, and may in some way be correlated with the parasitic habit of the genus. Bonnet (1912) and Mascré (1921), by whom the tapetal development of many Angiosperms has been observed, regard the multinucleate condition as characteristic for mature tapetal cells. Many binucleate cells were found by Gates and Rees (1921) among the more commonly occurring quadrinucleate tapetal cells of *Lactuca*, and a persistent uninucleate tapetum is recorded in *Lathyrus* (Latter (1926)). The marked differentiation of the tapetal layers on opposite sides of the loculus, and the uniform character of the cells on each side as found in *Lathræa*, is a condition not hitherto recorded in tapetal studies.

The plasmodial type of tapetum is now known to be of frequent occurrence in the microsporogenesis of Angiosperms. Records of many instances are given by Juel (1915) and Tischler (1915), whose results, together with those of Pickett (1916), are given by Gates and Rees (1921) with reference to the appearance of a similar type of tapetum in *Lactuca*. *Lathræa* may now be added to this list of Angiosperms for which a tapetal plasmodium is characteristic.

DISCUSSION.

NUCLEOLAR INCLUSIONS AND THE RELATION OF THE NUCLEOLUS TO THE CHROMOSOMES.

The constant association of the post-synizetic reticulum with one or more nucleolar bodies is a condition comparable to that first recorded in *Lathyrus* (Latter (1926)), in which one loop of the open spireme is constantly in connection with a single nucleolar body situated peripherally on the nucleolus. In *Lathræa* the nucleolar bodies show variation in size, number and distribution, as contrasted with the more uniform single structure of *Lathyrus*, and the mode of attachment of the thread in the two forms is dissimilar. The fact that the time of association of the thread with the nucleolar body coincides with the period of chromatic thread formation in both forms strongly suggests that the function of the body is connected with the elaboration of chromatin and its transference to spireme or reticulum. Further evidence in support of this view was put forward from observations on *Lathyrus*, and the following facts provide similar evidence from *Lathræa*. Firstly, the heavily thickened portions of the thread which are in direct communication with the nucleolus are indicative of an outflow of material from that structure; and secondly, the constant appearance of nucleolar vacuoles at the time of chromatic

thread formation suggests utilization of nucleolar substance in chromatin elaboration.

The occurrence of crystal bodies in the nucleoli of the resting pollen mother-cell nuclei suggests the possibility of the later formed nucleolar bodies being derivatives of these crystalline inclusions. Similar crystal bodies are recorded in the nucleoli of the resting pollen mother-cells in *Lathyrus* (Latter (1926)) and *Oenothera franciscana* (Cleland (1922)), and have recently been observed in several other species of *Oenothera*. The presence of such crystal-like inclusions in all these forms is followed by the appearance in the postsynizetic stages of a dark-staining nucleolar body or "endonucleolus." Evidence favouring the interpretation of the nucleolar body as a derivation of the crystal body was obtained from the study of *Lathyrus*. In *Lathræa*, crystal bodies may also be present in the nucleoli during diakinesis, which fact suggests the possibility of the crystal body forming the central core of the nucleolar body, and when the work of chromatin elaboration is completed only the crystal-like core remains. At present, however, no definite conclusions can be made regarding the relationship of these two dissimilar types of nucleolar inclusion.

Crystalline material is known to occur also in the nucleoli of the tapetal cells of *Lathyrus*, of the root tip cells of *Galtonia candicans* (Digby (1910)) and *Allium* (Reed (1914)), also in the endosperm nucleoli of *Macrozamia* (Light (1924)) and the pollen mother-cells of *Zea Mays* (Kuwada (1919)), but no evidence is given suggestive of their possible function. It seems probable, however, from their constant occurrence in cells entering upon a period of increased activity, that the crystal bodies are in some way associated with the metabolic processes of the cell.

The small papillæ which project from the nucleoli of the synizetic nuclei do not seem to bear any relation to the nucleolar bodies, or to be in any way associated with the reticulum. Their appearance may possibly be an expression of internal nucleolar activity.

The absence of any flattening of the nucleolus against the nuclear membrane is in contrast with the extreme crescent shapes often assumed by the nucleolus of *Lathyrus*. It was suggested in that case that the flattening of the nucleolus against the nuclear membrane was of significance in the absorption of cytoplasmic materials for future chromatin elaboration, and that the homogeneous appearance of the nucleolus in that condition might be due to the inflow of such materials and their passage across the nucleolus to the nucleolar body. In *Lathræa* both the crescent shape and homogeneous appearance of the post-synizetic nucleolus are absent, the vacuolate condition of this latter structure being evident during the entire process of chromatic thread formation. Obviously then the process of chromatin elaboration is not exactly similar in both these plant forms. In *Lathyrus*, both cytoplasmic and nucleolar materials appear to play their respective parts in chromatin formation, while in *Lathræa* this rôle seems more especially confined to the nucleolus.

CHROMOSOME FORMATION AND METHOD OF PAIRING.

The formation of somatic chromosomes from the prophaseic reticulum is a well known phenomenon, and has been described in detail by Gates (1912), Digby (1914), Sharp (1920), and other cytologists. The persistence of a reticulum in the post-synizetic nucleus of the pollen mother-cells of *Lathræa* is a phenomenon not previously recorded in plant cytology.

Normally, the synizetic knot provides a stage from which one or more unbranched threads emerge, displaying no trace of the anastomosing nature of the presynizesis reticulum. The significance of synizesis in *Lathræa* is not evident; the reticulum enters the synizetic knot, from which a reticulum emerges, differing only from the former one in clearer definition of the thread due to continued chromatin deposition.

The chromatic aggregations shown on the reticulum in figs. 21 and 22, indicate that neither a parasynaptic nor a telosynaptic method of pairing takes place. In the earlier stages no pronounced parallelism of portions of the reticulum is observed, but in early diakinesis union of certain homologous chromosomes in telosynaptic formation is recorded. Thus, though a tendency to ultimate end-to-end union of homologues is evident, the method of pairing on the reticulum may take an intermediate position between typical parasynapsis and telosynapsis.

The maintenance of a reticulum throughout the postsynaptic stages, and the subsequent formation of chromosomes on this retiform structure with the omission of pachynema formation, indicates a lowly type of nuclear specialisation which may perhaps be correlated with the parasitic nature of the plant. The nuclear behaviour of *Lathræa* suggests that in the course of nuclear evolution some similar method of chromosome formation may have existed, and that a specialised spireme was evolved later, with the consequent parasynaptic or telosynaptic pairing of its constituent chromosomes.

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SUMMARY.

1. Two species of *Lathræa*, *L. clandestina* and *L. squamaria*, have been cytologically examined during microsporogenesis, and are found similar in all stages of development. The chromosome number in each is determined as twenty-one haploid, forty-two diploid.
2. Each resting pollen mother-cell nucleus contains a large nucleolus in which crystal bodies are present, and from which a small papilla projects.
3. Chromatic aggregations, which are not prochromosomes, are present on the presynizetic reticulum and can also be recognised in the synizetic knot.
4. No spireme is formed at the loosening of the synizetic knot, but the reticulate character of the thread is retained until the formation of the chromosomes is complete.

5. Chromosome formation appears to take place by a flowing together of the chromatin on the post-synizetic reticulum, so that it is ultimately present as definite aggregations irregularly distributed along the branched threads. These aggregations remain for a time connected by delicate filaments. In diakinesis the connections are absorbed and the bivalents become independent of one another.

6. The chromatic reticulum maintains a constant connection with the nucleolus. At the points of attachment, dark-staining nucleolar bodies are present; these vary in number, size and distribution. The portions of thread nearest the nucleolus may be much thickened as though by an exudation of nucleolar material.

7. The nucleolus persists as a spherical structure until metaphase and is constantly vacuolate during the process of chromosome formation.

8. The above facts support the view that the nucleolus contributes material to chromosome formation.

9. The method of chromosome pairing is considered to be intermediate between parasynapsis and telosynapsis, and may represent a more primitive phase in nuclear evolution.

10. Multipolar spindles are formed prior to the establishment of the bipolar forms, and simultaneously the nucleolus disappears and is represented by fragments in the cytoplasm.

11. The heterotypic and homotypic divisions occur normally, except for an extremely late appearance of the homotypic split.

12. No resting nuclei are found during interkinesis.

13. Twenty-one chromosomes and a single large nucleolus can be distinguished in each grand-daughter nucleus. The identities of these chromosomes are gradually lost by the formation of anastomosing strands between them, and ultimately a typical resting reticulum is established within each microspore nucleus.

14. The phenomenon of cytomyxis is observed in prophase and interkinesis.

15. The tapetum on the outer wall of the loculus is differentiated from that on the inner, the former being uninucleate, the latter binucleate throughout all the stages of pollen development.

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EXPLANATION OF PLATES.

Figures 2–47 were drawn with a camera lucida, and have been reproduced without reduction. Figs. 2 and 3 were drawn under a 4.2 mm. Zeiss with Zeiss Comp. Oc. 2. Magnification 430. Figs. 4–47 were drawn under a 2 mm. imm. Zeiss N.A. 1.4, with Zeiss Comp. Oc. 12. Magnification 2,400. Figures 48–51 are enlarged photo micrographs taken under a 2 mm. imm. Zeiss N.A. 1.4. Magnification about 1,200.

ABBREVIATIONS.

A.B. = Allen's Bouin fixative.
C.A. = Chrome-acetic fixative.
M. = Merkel's fixative.

PLATE I.

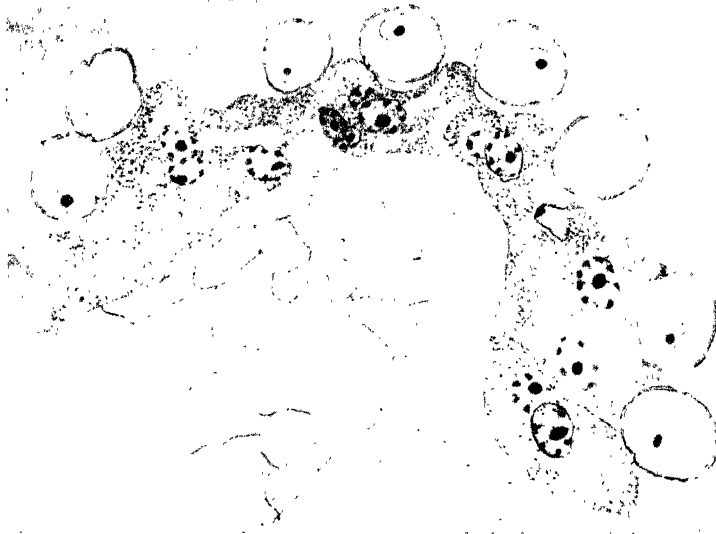
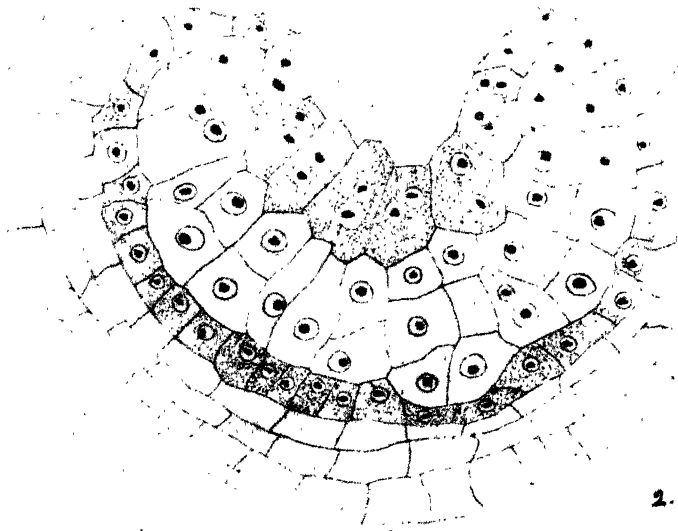
- Fig. 2.—*L. clandestina*. T.S. of loculus containing archesporial tissue and well-defined tapetum, the outer layer of which is uninucleate, the inner layer binucleate. (C.A.)
- Fig. 3.—*L. clandestina*. Tapetal plasmodium encroaching amongst the young pollen grains. (C.A.)

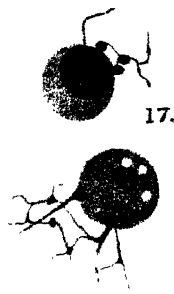
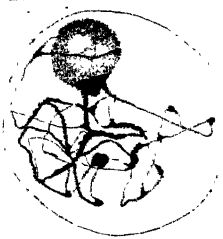
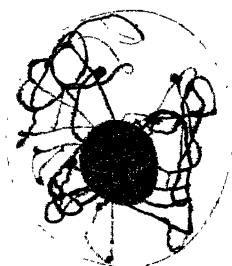
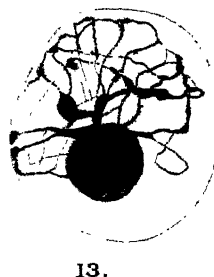
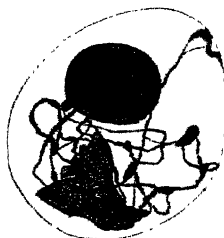
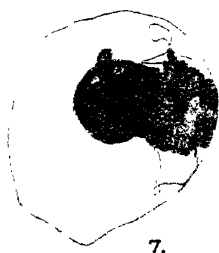
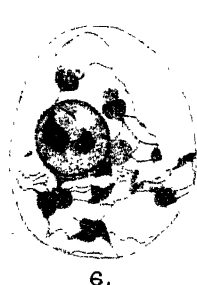
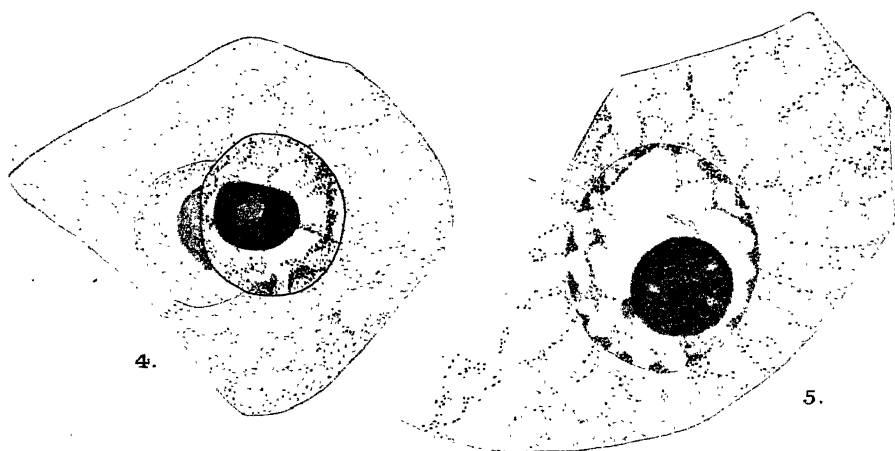
PLATE II.

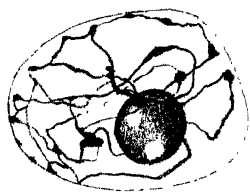
- Fig. 4.—*L. clandestina*. A binucleate archesporial cell. (C.A.)
- Fig. 5.—*L. clandestina*. A resting pollen mother-cell with vacuoles and crystal bodies in the nucleolus. (C.A.)
- Fig. 6.—*L. clandestina*. Presynizetic nucleus, with chromatic aggregations held in the meshes of the fine reticulum. (C.A.)
- Figs. 7, 8.—*L. clandestina*. Synizetic knot. (C.A.)
- Figs. 9, 10.—*L. squamaria*. Synizetic knot. (C.A.b.)
- Fig. 11.—*L. clandestina*. Early loosening of synizetic knot, with attachment of reticulum to nucleolar bodies. (C.A.)
- Fig. 12.—*L. clandestina*. Further loosening of the synizetic knot, and establishment of a reticulate thread. (A.B.)
- Fig. 13.—*L. clandestina*. Loosening of the synizetic knot. Thickened portions of the thread are in contact with the nucleolus. (A.B.)
- Fig. 14.—*L. clandestina*. Uniform distribution of the post synizetic reticulum throughout the nuclear cavity, and attachment to the nucleolus by nucleolar bodies. (A.B.)
- Figs. 15, 16.—*L. squamaria*. Post synizetic reticulum attached to nucleolus by nucleolar bodies. Preparations destained. (A.B.)
- Figs. 17, 18.—*L. squamaria*. Nucleoli with portions of reticulum attached to nucleolar bodies. Preparations destained. (A.B.)

PLATE III.

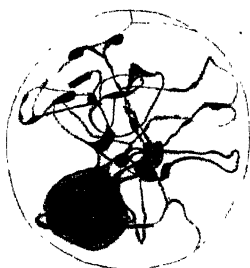
- Fig. 19.—*L. clandestina*. Post synizetic reticulum attached to nucleolus by nucleolar bodies. Preparation destained. (C.A.)
- Fig. 20.—*L. squamaria*. Formation of chromosomes on reticulum. (A.B.)
- Figs. 21, 22.—*L. clandestina*. Later stage of chromosome formation on reticulum, only parts of which are figured. (M.)
- Fig. 23. *L. clandestina*. Early diakinesis. Remnants of the reticulum are still seen as connecting strands between certain bivalents. There is some evidence of a telosynaptic arrangement of the chromosomes. Twenty-one pairs present. (C.A.)
- Fig. 24.—*L. squamaria*. Early diakinesis. One of the twenty-one bivalents is still attached to the nucleolus. (A.B.)



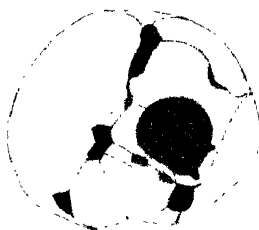




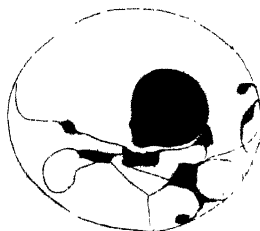
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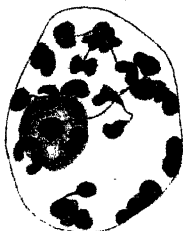
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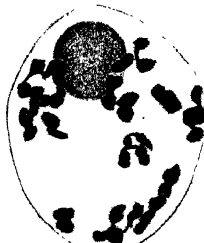
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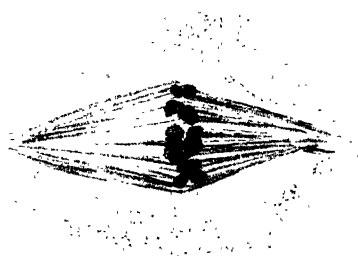
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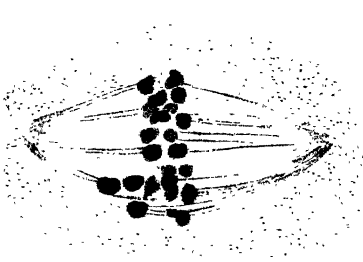
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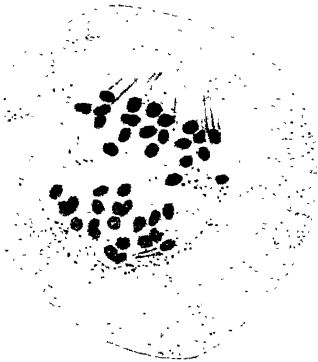
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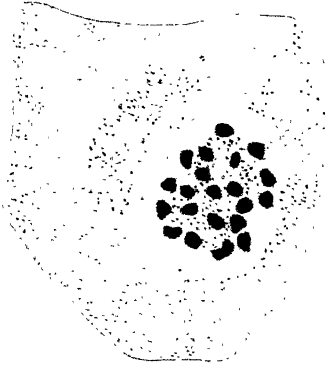
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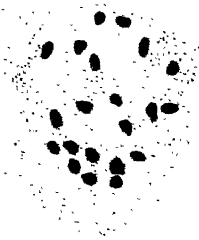
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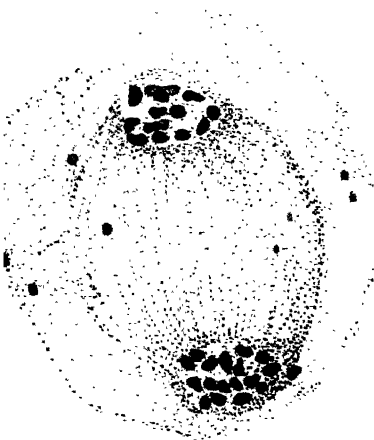
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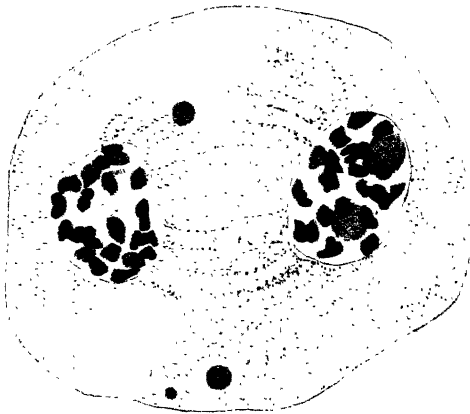
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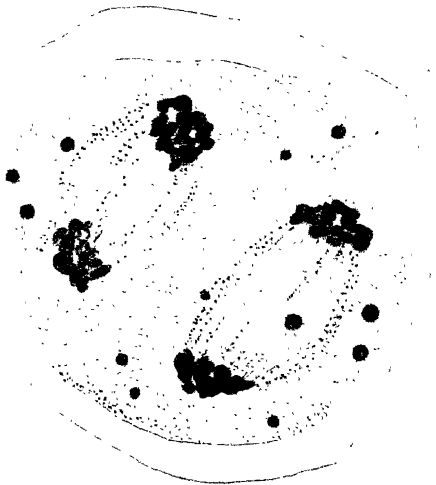
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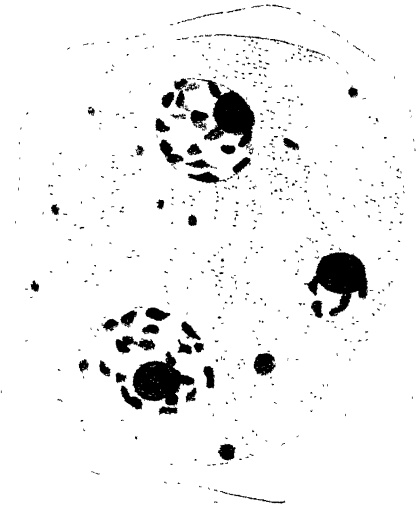
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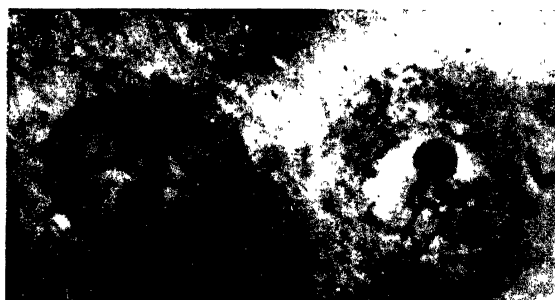
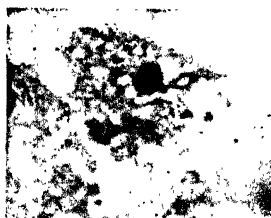
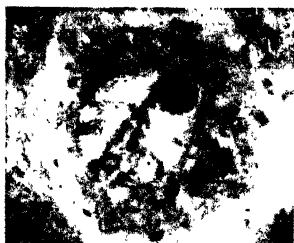
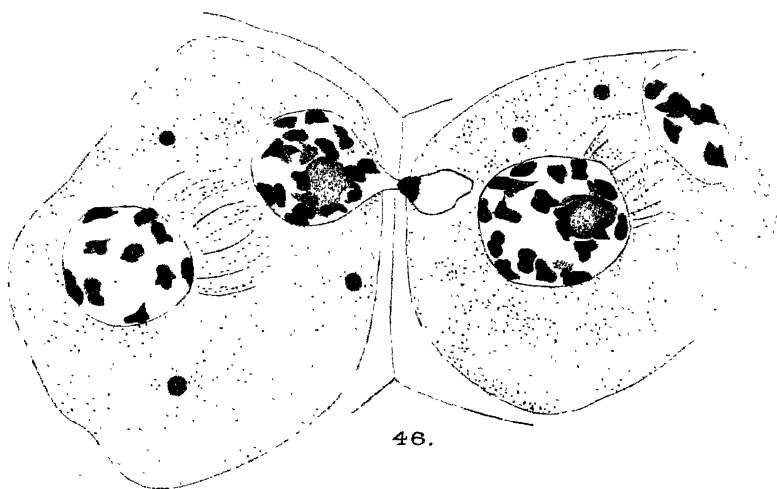
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45.



- Fig. 25.—*L. squamaria*. Diakinesis. Twenty-one bivalents showing end-to-end arrangement of homologous chromosomes. (A.B.)
 Fig. 26.—*L. clandestina*. Diakinesis. Twenty-one pairs of chromosomes are present. Nuclear membrane heavily defined. (C.A.)
 Fig. 27.—*L. clandestina*. Early spindle formation. Twenty-one pairs of chromosomes are present. (C.A.)
 Fig. 28.—*L. clandestina*. Multipolar spindle. Nuclear membrane remaining almost completely intact. The nucleolus has fragmented. Twenty-one pairs of chromosomes are present. (C.A.)
 Fig. 29.—*L. squamaria*. Tripolar spindle. Nucleolar remains are present in the cytoplasm. Twenty-one bivalent chromosomes are present on the spindle. (A.B.)
 Fig. 30.—*L. clandestina*. Heterotypic metaphase. (C.A.)

PLATE IV.

- Fig. 31.—*L. clandestina*. Early heterotypic anaphase. Eleven pairs of chromosomes are visible. (C.A.)
 Fig. 32.—*L. squamaria*. Heterotypic anaphase. Twenty-one chromosomes are approaching either pole. Four are lagging on the spindle. (A.B.)
 Fig. 33.—*L. squamaria*. Heterotypic anaphase. Twenty-one chromosomes distributed to either pole, showing no signs of the homotypic split. (A.B.)
 Fig. 34.—*L. clandestina*. Polar view of one chromosome group (twenty-one chromosomes) in heterotypic anaphase. (C.A.)
 Fig. 35.—*L. squamaria*. Polar view of one chromosome group (twenty-one chromosomes) in heterotypic anaphase. The chromosomes appear slightly smaller than in *L. clandestina*. (A.B.)
 Fig. 36.—*L. clandestina*. Heterotypic telophase. Eighteen and fifteen chromosomes seen at each end respectively. (A.B.)
 Fig. 37.—*L. clandestina*. Interkinesis. Twenty-one univalent chromosomes in each daughter nucleus. Nucleoli and nuclear membranes are formed. Nucleolar fragments are present in the cytoplasm. (A.B.)

PLATE V.

- Fig. 38.—*L. clandestina*. Nucleus during late interkinesis. Anastomosing strands are formed between the chromosomes. (A.B.)
 Fig. 39.—*L. clandestina*. Homotypic metaphase; bipolar and tripolar spindles present. (C.A.)
 Fig. 40.—*L. clandestina*. Homotypic anaphase. (M.)
 Fig. 41.—*L. clandestina*. Homotypic telophase. The chromosomes are extremely compact and appear to fuse with one another. (M.)
 Figs. 42, 43.—*L. clandestina*. Single telophasic groups of chromosomes which are separating from one another, while nuclear sap is formed between them. (M.)
 Fig. 44.—*L. clandestina*. Formation of the pollen tetrad nuclei. The twenty-one chromosomes of each are distinct from one another. (M.)
 Fig. 45.—*L. clandestina*. Formation of resting reticulum of microspore nucleus. (A.B.)

PLATE VI.

- Fig. 46.—*L. clandestina*. Cytomixis during interkinesis. This preparation was not stained to show up the thick mother-cell wall, whose outlines in consequence could not be followed. (A.B.)
 Fig. 47.—*L. clandestina*. Single nucleus of a cell of the outer tapetal layer showing twenty-one chromatic bodies and a large nucleolus.
 Figs. 48-50.—*L. squamaria*. Post-synizetic reticulum attached to nucleolus by one or more nucleolar bodies. (A.B.)
 Fig. 51.—*L. squamaria*. One loop of the post-synizetic reticulum shows uneven distribution of chromatic beads, and attachment to the nucleolus by the papillate nucleolar body. (A.B.)

XI.—THE MICROSCOPIC CHARACTERS OF CERTAIN HORIZONS OF THE BRITISH CHALK.

By I. S. DOUBLE, M.Sc., F.G.S., University of Liverpool.

(Read at the LIVERPOOL CONFERENCE, March 1927.)

ALTHOUGH from the very nature of the Upper Chalk, the results yielded by a petrological investigation must be very scanty, it is none the less desirable to place on record those that have been obtained. These notes deal particularly with the chalk of the Gipping Valley (Geological Survey Map, New Series, Sheet 207), but for comparative purposes material from other parts of Norfolk and Suffolk has been examined and, as the tables given below show, the composition and petrological composition is so uniform throughout this area that it appears unlikely that further investigation would add materially to the information now recorded.

In the Gipping Valley the chalk is exposed in numerous quarries and pits, full details of which are to be found in the Geological Survey Memoir (Sheet 207). Many of these are, however, rarely worked now. The rock, soft and creamy-white in colour, is usually well bedded and jointed and has occasional layers of spindly flints. Fossils are very rare, but sufficient have been recorded to prove the presence of a few feet of the zone of *Belemnitella mucronata* resting on the zone of *Actinocamax quadratus* at Bramford and Claydon. The zone of *Marsupites*, and sub-zone of *Uintacrinus*, are found at Monk's Eleigh and also further west at Sudbury. The beds have a low south-easterly dip in this area, but as the upper surface is bevelled off under the Eocene overstep at a greater angle, it is unlikely that the *B. mucronata* zone extends far beneath that cover. The strike, however, changes just north-east of Ipswich and becomes nearly north-south, so that the *B. mucronata* zone is again found at Norwich, whilst the highest horizon of the British chalk, the *Ostrea lunata* zone, outcrops at Trimingham.

In spite of the voluminous literature dealing with the Cretaceous deposits, very little reference has been made to the petrography, and so far as can be ascertained, no petrological work has been published concerning the area under discussion. Hume (1893) has dealt both chemically and mineralogically with similar horizons in the South of England and also in County Antrim (1897). Jukes-Browne and Hill (1904) quote Hume's results and also give chemical analyses of the Eastern Counties chalk, but no petrological details. The contributions of Cayeux (1897) deal with the chalk of Northern France. Bailey (1924), after dealing specifically with the

chalk of Mull and Morvern, discusses the importance of secondary silicification and of the presence of rounded grains of quartz in other areas. Tarr (1925), in endeavouring to show that the chalk may be a chemical deposit, quotes the results of other workers, but gives no new information.

In view of the numerous chemical analyses of the chalk in existence it was not considered necessary to make others. However, two by local industrial concerns, hitherto unpublished, are included for comparative purposes. Many partial analyses however were made to ascertain the percentage soluble in dilute acid and also the quantity of calcium carbonate present. The insoluble residues from these analyses were too small to yield satisfactory results from microscopic examination and larger quantities had to be obtained. As solution in acid proved to be very wasteful, large quantities of chalk were first gently pulverised under water. The suspended matter was floated off and the resulting chalky sand was then treated with dilute acid. By this means a few mineral grains and organic fragments, together with much clayey matter were obtained.

CHEMICAL COMPOSITION.

Through the courtesy of Messrs. Packard and Co. (Chemical Manure Manufacturers, Bramford) and of Messrs. Mason and Co. (Cement Manufacturers, Claydon) two analyses, made for industrial purposes, are quoted :

	Bramford.		Claydon.
		Recalculated without water.	
Calcium Carbonate	74.17	96.37	97.0
Oxide of Iron and Alumina .. ..	.77	1.00	.23
Alumina	—	—	.08
Magnesia	—	—	1.19
Sulphur Trioxide	—	—	.15
Silica	—	—	.09
Insoluble residue .. ..	.65	.85	.96
Organic matter	1.37	1.78	.13
Moisture	22.66	—	—
	99.62	100.00	99.85

As it was evident the Bramford analysis was made on the ordinary damp chalk from the quarry, that analysis has been recalculated without water. Both these analyses are of the chalk of the *A. quadratus* zone. It will be noticed that the calcium carbonate content is very high, about 97 p.c., whilst the insoluble residue is less than 1 p.c. Iron and alumina are present in both cases ; indeed, they are probably always present

in any sample. Magnesia never occurs in any quantity, and seems somewhat sporadic, for several partial analyses have yielded either negative results or mere traces of that element.

TABLE I.—Percentage weight of Chalk soluble in Hydrochloric Acid.

—	<i>B. mucr.</i>	<i>A. quad.</i>	<i>Marsu- pites.</i>	<i>O. lunata.</i>	Percentage of CaCO ₃ .
Claydon, Roadside pit	99·24	—	—	—	98·3
Bramford	99·38	98·83	—	—	99·1
Claydon, Mason's pit ..	—	98·94	—	—	98·92
Barking	—	98·91	—	—	98·8
Baylham	—	98·77	—	—	97·2
Coddensham	—	99·24	—	—	98·0
Creting	—	98·92	—	—	98·5
Shrubland	—	98·55	—	—	—
Jordan's pit, Sudbury 1	—	—	98·69	—	98·5
Middleton Road, „ 2	—	—	98·91	—	98·5
Monk's Eleigh	—	—	99·22	—	98·3
Whitlingham	—	98·56	—	—	97·1
Burgh, near Aylsham ..	—	98·5	—	—	—
E. of West Runton Gap	—	98·76	—	—	—
Trimingham	—	—	—	97·58	97·5
*Culver Cliff	98·143	—	—	—	—
*Studland Bay	99·41	—	—	—	—
*Pinnacles, Isle of Wight	—	—	99·151	—	—

* Quoted from W. F. Hume.

PARTIAL ANALYSES.

Table I. shows the relative amounts soluble in diluted hydrochloric acid from various parts of the area, and also the approximate amount of calcium carbonate present.

The results from these partial analyses show a somewhat higher percentage of calcium carbonate than the full analyses. The method adopted may account for this. Half a gramme of dried selected chalk was dissolved in acid, filtered and thoroughly washed. The filtrate was rendered alkaline with ammonia and the lime precipitated as oxalate by the addition of ammonium oxalate. After filtering and washing, the precipitate was ignited and weighed as lime. In this precipitate part of the iron and alumina may be present, but as the full analyses show how little of these is present the method is probably sufficiently accurate for comparative purposes. Hume's figures for similar horizons on the South Coast show that the results approximate closely. From these analyses it is evident that the rock is essentially composed of calcium carbonate.

INSOLUBLE RESIDUES.

TABLE II.—*Detrital Minerals—Upper Chalk.*

—	<i>Marsupites.</i>				<i>A. quadratus.</i>							<i>B. mucronata.</i>					<i>Ostrea lunata.</i>
	Sudbury. 1.	Sudbury. 2.	Monk's Eleigh.	(Hume.)*	Claydon.	Bramford.	Barking.	Baylham.	Shrubland.	Coddenham.	Creeting.	Claydon.	Bramford.	Norwich.	Burgh.	(Hume.)*	Trimingham.
Iron oxides ..	x	x	—	x	x	x	—	—	x	x	x	x	—	—	—	—	—
Pyrites ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Garnet ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rutile ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zircon ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tourmaline ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Quartz ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Andalusite ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Staurolite ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chlorite ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Epidote ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Felspar ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hornblende ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mica ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sphene ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kyanite ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Glaucouite ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* The results given under Hume are, in both cases, compiled from his tables.

Table II. shows the various mineral species that have been identified in the residues after treatment with acid. Besides the minerals listed, a manganese mineral is occasionally present as dendritic markings on joint-planes. Most of the dendritic growths are, however, iron. The quantity of residue in any sample is always very small, probably less than 0.01 p.c. In a quantitative test, 77.1 gr. of chalk from the *A. quadratus* zone from Bramford was dissolved and the residue, after the flocculent clayey material had been decanted off, amounted to 0.0015 gr. (= 0.002 p.c.). The difference between the percentage of calcium carbonate present and the percentage of mineral grains is represented by a very fine brownish mud, which sticks to filter papers and is unresolvable under the microscope. It can only be termed clay-like material.

Among the recognisable minerals quartz is always most abundant, then felspar and usually glauconite. Zircon is ever present, whilst very few residues are devoid of tourmaline and rutile. It will be noticed that the residues only contain minerals which generally occur in sediments and which have little correlative value.

Magnetite occurs as small rounded grains which are frequently coated with limonite.

Garnets, both colourless and faintly brown, occur as fractured grains. Cleavage is never apparent and they are quite isotropic.

Zircon is found both as small prisms with clean-cut faces and also as rounded grains—the latter are occasionally purple or brown in colour.

Rutile.—Both red and yellow varieties are present.

Tourmaline.—Prisms with good crystalline form are extremely rare. Usually the mineral occurs as rounded or broken stumpy prisms. Various tints are noticeable, and very strong absorption is general.

Quartz is usually angular to subangular in form, though a few rounded grains about 0.1–0.4 mm. in diameter have been seen.

Chalcedonic aggregates are occasionally found. No trace of organic structure in these has been seen.

Hornblende is not of common occurrence. A few small green cleavage flakes showing faint pleochroism and with extinctions up 12° are present.

Chlorite occurs as thin green flakes, which are nearly isotropic, but show a feeble pseudo-uniaxial figure of positive character.

Felspars are occasionally nearly as common as quartz. Orthoclase, an acid plagioclase, and one grain of microcline have been identified.

Glaucinite as rounded grains and also as pseudomorphs after foraminifera (e.g. *Globigerina*) is of general occurrence. It has a low refractive index and shows aggregate polarisation.

Mica is colourless and has a fairly wide optic axial angle.

Kyanite has been identified in two residues only.

Sphene has been identified in one residue only.

Marcasite nodules frequently occur in the chalk, but the mineral rarely occurs in the residues.

The minerals listed above are all such as are commonly found in sedimentary rocks and are in striking contrast to those found in the deep-sea deposits. According to the Challenger Reports, among the minerals found in the *Globigerina* Ooze are augite, hornblende, olivine, felspars, magnetite, with lapilli and pumice. These are evidently products of volcanic activity, whilst those found in the chalk are such as would be derived from the denudation of land-masses. However, detrital minerals are so rare in the chalk that it seems improbable that they were carried in by streams; they were possibly wind-borne into the Chalk Sea. The rounding of many of the grains, especially of quartz of diameter less than 0.5 mm. also points to at least semi-arid conditions during denudation.

THIN SLICES.

Thin slices of the Upper Chalk show very scanty organic remains; only occasional foraminifera, shell-fragments, sponge-spicules or *Inoceramus*-prisms can be seen. The greater part of any slide is occupied by what has been termed amorphous material. Jukes-Browne and Hill (1904) calculated the percentage of this to be 50 p.c. in the *O. lunata* zone, 70–90 p.c. in the *B. mucronata* zone and 80–85 p.c. in the *A. quadratus* zone, the remainder

consisting of spheres and organic remains. The spheres are rounded bodies about 0.06–0.08 mm. in diameter which show no apparent structure and are filled with the amorphous substance, so that these percentages if anything, err on the low side. Tarr (1925) also discusses the occurrence of this amorphous material and endeavours to show that it is probably a chemical precipitate. These notes are not concerned with that question, though it might be pertinent to point out that the theory of the chalk being composed essentially of organic remains has long been abandoned by workers on the formation in this country.

The so-called amorphous material is seen from the chemical analyses to consist of calcium carbonate, but Johnson, Williamson and Merwin (1916) have shown that all forms of calcium carbonate are crystalline. Dry chalk is very friable and a soft camel hair brush will remove fine particles from it. If these be mounted in a suitable oil and examined under the microscope they are seen to consist of minute prismatic fragments which have crystalline properties—they react to polarised light and extinguish with the rotation of the stage. A like result is obtained if the fine material that remains suspended in water after two minutes is similarly mounted and examined. Thus it would appear that the main mass of the chalk is not amorphous but crystalline.

SUMMARY.

In the Gipping Valley three zones of the Upper Chalk are exposed, the *Marsupites* zone, sub-zone *Uintacrinus*, the *Actinocamax quadratus* zone and the *Belemnitella mucronata* zone.

Chemical analyses show that the Upper Chalk is almost pure calcium carbonate there being usually less than 3 p.c. of other material. This consists largely of clay, but there are also present detrital grains of iron oxides, garnet, zircon, rutile, tourmaline, quartz, andalusite, staurolite, chlorite, epidote, feldspar, hornblende, mica, sphene, kyanite and glauconite. These, however, only occur sparsely, probably less than 0.01 p.c. of detrital grains being present. The rounding of small grains and the rarity of the detrital minerals is considered to indicate that they were wind-borne into the Chalk Sea.

Thin sections show that the greater part of the Upper Chalk consists of the so-called amorphous material and that organic remains are very scarce. This so-called amorphous material consists of calcium carbonate and is crystalline since it reacts to polarised light.

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XII.—PNEUMOKONIOSIS DUE TO ASBESTOS DUST.

By W. E. COOKE, M.D., M.R.C.P., F.R.M.S., and
C. F. HILL, M.Inst.M.M., A.Inst.P., F.R.M.S.

(*Read at the LIVERPOOL CONFERENCE, March, 1927.*)

EIGHT TEXT FIGURES.

ONE of us (W. E. C. 1924) has already published a short note on the case which is the subject of this paper.

The only similar case on record was a man admitted to the Charing Cross Hospital in 1899, where he died in 1900. Dr. E. L. Middleton of the Home Office kindly lent us the notes of the case, and of the evidence given before the Departmental Committee on Industrial Diseases in 1906 by the late Dr. H. Montague Murray, under whose care the man had been. This patient, a man aged 33 years, had worked in the carding room of an asbestos factory for ten years prior to his admission to hospital. He stated to Dr. Murray that he was the sole survivor of ten men who started work with him in the carding room. The others had died presumably as the result of their occupation. A post-mortem examination was held, and the diagnosis of pulmonary fibrosis confirmed, and Dr. Murray in his evidence refers to photo-micrographs of lung sections which show "spicules of asbestos." These are the salient facts of the first, and up to 1924, the only record of a death due to asbestos.

That these two cases stand alone is very surprising. The asbestos industry is more than 2,000 years old and we know that asbestos factories, up to quite recent years, have been devoid of any appliances for the prevention and extraction of dust. The remark of Dr. Murray's patient is suggestive, and medical men have long suspected asbestos dust to be the cause of lung conditions in workers in badly ventilated factories.

Asbestos is a physical paradox—a mineralogical vegetable, both fibrous and crystalline, elastic, and brittle; as capable of being carded, spun and woven as wool, flax or silk. A single strand can be spun to weigh less than an ounce to 100 yards, and a cloth manufactured which weighs less than 8 ounces to the square yard.

It occurs in every country, but is never found in any two countries alike, nor, indeed, in any two parts of the same country.

Historical.—Asbestos is apparently indestructible, and its fire resisting qualities were known to the ancients. The Romans mined it from the Italian Alps and the Ural Mountains.

Herodotus (circa 450 B.C.) described a cremation cloth made from asbestos.

Pliny (circa 50 A.D.) mentions the difficulty in weaving it. Strabo (circa 30 B.C.) and Plutarch (circa 70 A.D.) both speak of the wicks of the lamps of the Vestal Virgins being made from asbesta, so called because they maintained a perpetual flame without being consumed.

Pausanius (circa 175 A.D.) refers to a gold lamp made by Callimachus of Athens for Minerva, the wick of which was made of Carpasian linen, "the only linen which is not consumed by fire."

And later—A.D. 1250, Marco Polo writes that he had seen Tartars using cloth that withstood fire which was made of a "Certaine Minerall of Earth found in a Mountayne."

Although its valuable properties have been known for thousands of years the modern adaptation of asbestos to the industrial arts dates from only a few years ago.

Composition.—Asbestos is one of the silicates, and its varieties are numerous.

Wherever it occurs it is found associated with other minerals, more especially with chrome iron and magnetite.

The composition of the well-known Italian and Canadian fibres is as follows:—

	Italian Fibre.	Canadian Chrysotile.
Silica	40·30	40·87
Magnesia	43·37	41·50
Ferrous Oxide	0·87	2·81
Alumina	2·27	0·90
Water	13·72	13·55

The purest asbestos, which has fibres of extraordinary length, occurs in Northern Italy.

Asbestos may contain from 0·5 p.c. to 15 p.c. of iron oxide, but asbestos yarn is prepared from mineral as free as possible from iron.

To get rid of the difficultly soluble iron, asbestos is soaked in orthophosphoric acid solution and washed in water before manufacture.

The percentage of iron, then, is of recognised importance.

Manufacturing Process.—The process of manufacture resembles that of cotton. The crude mineral is subjected to mechanical treatment in a grinding machine. The heavier rock is separated by gravity, and the remaining asbestos passed through carding, roving and spinning machines, and from these to the weaving sheds.

During the carding process, and to a less extent in all the processes, a very considerable amount of dust is generated. In modern factories all machines are fitted with covers and the dust removed by extraction. In the first factory where the subject of the present paper was employed, no method of dust removal was used, and the atmospheric conditions were occasionally so bad that workers in her particular room could not see each other.

Asbestos Fibre and Dust.—Microscopically, asbestos fibre is seen to consist of two very different elements. The bulk of the fibre is translucent and glistening, and doubly refractile, with, here and there, black opaque angular particles (fig. 1). Minute black granules also are present. These black particles are actually part of the fibre, but their appearance suggests a different chemical composition and different physical characters to the translucent portion.

The dust generated during manufacture is seen to consist (fig. 2) of these sharp angular particles and minute granules, suggesting, of course, that they are more brittle than the translucent part of the fibre.

These particles are found in very small numbers in the finished article. Mr. T. H. Byrom, F.I.C., analysed several samples of dust, and found that

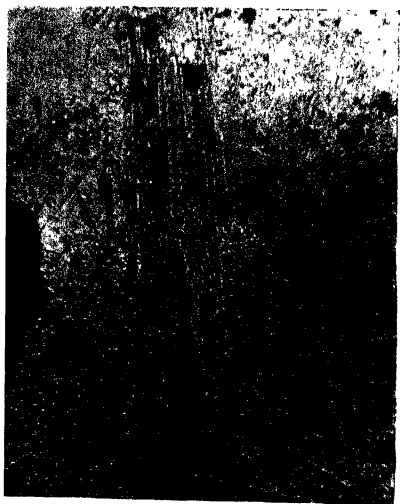


FIG. 1.



FIG. 2.

the dusts containing the greater numbers of these black particles contained the largest amount of iron. The iron content of the finished article, raw material, and dust are as follows:—

Finished Article.	Iron (as ferrous oxide)	0.1 p.c.
Crude raw material.	Iron (as ferrous oxide)	2.81 p.c.
Dust from carding room.	Iron (as ferrous oxide)	18.4 p.c.

From these results it appears conclusive that the black brittle parts of the asbestos fibre are the iron containing portions—the bugbear of the manufacturer, the cause of “dust,” and the danger to health of workers in the process of manufacture.

Clinical History.—The deceased, a woman aged 38 years, commenced work at the age of 13 years in an asbestos factory in which no provision was

made for the extraction of dust. From an early age, soon after commencing work, she suffered from a cough, which did not interfere, apparently, with her general health until 1917. She was then 26 years of age, and had been working thirteen years. From this time until five years later, 1922, her attendances at work were intermittent owing to ill-health. She missed occasional days, and one or two periods of some weeks, until she finally ceased work in July, 1922.

Up to this she complained of cough, dyspnoea, expectoration, and lassitude. The physical signs in her chest were those of fibrosis of the right lung.

In July, 1922, signs of cavitation were noticed, the sputum became more profuse, and she suffered from sweats and irregular temperature, and died on March 14th, 1924.

An X-ray plate showed extensive fibrosis, more marked in the right lung, two calcareous glands at the root of the left lung, and two small calcareous particles in the base of the left lower lobe.

MACROSCOPICAL APPEARANCES.

Right Lung.—The pleura was thickened over the entire surface of the lung, and showed the remains of dense adhesions to the chest wall and pericardium. The lung was firm and small. The glands at the root of the lung were large, black, showed a thickened capsule, and some calcareous particles. The lung was fibrosed and to a large extent airless, the lung tissue being replaced by fibrous tissue. Dense strands of fibrous tissue from the pleura intersect the lung. In the apex there was a large cavity, the size of a peeled tangerine orange. The middle and lower lobes showed numerous small areas—varying in size from a hazel-nut to a pin's head—of caseation, some of which have proceeded to cavitation. The bronchi were dilated.

Left Lung.—The pleura was thickened and showed the remains of adhesions to the chest wall. The thickening and adhesions were not so marked as in the right lung. The lung was firmer than normal. At the root of the lung were two large calcareous masses, one the size of a large hazel-nut, the other about half that size—calcified tuberculous glands. The other glands were black and showed periadenitis. In the left apex there was an area of old scar tissue about the size of a sixpenny piece, and a cavity the size of a walnut. Scattered throughout the lung were small areas of denser consistence than the rest of the lung, some of which showed definite calcareous particles, others, small areas of caseation. There was a considerable increase in the fibrous tissue.

MICROSCOPICAL APPEARANCES.

The changes in the lungs are more marked in the right lung. There is a diffuse interstitial pneumonia with endarteritis of the smaller arteries, some of which are thrombosed and organised. Many of the bronchi are obliterated by fibrous tissue. Some are in communication with caseous areas which show typical tuberculous lesions and cavities. The walls of the

bronchi and alveoli are thickened, and the condition is typical of a progressive pneumokoniosis with a superadded tuberculous infection. Three outstanding features are presented by sections from this case.

The first is the enormous amount of fine granules in the peribronchial fibrous tissue, walls of alveoli, and in phagocytes scattered through the sections. The particles of this dust are similar in size and shape to the black granules seen in the asbestos fibre.

The second unusual feature is the presence of large solid angular particles. These are situated in areas of fibrosis and in caseating areas. They vary in size from 3 to 360 microns in length. The particles are so large,—masses of them are seen in certain areas,—that they must have occluded small bronchi.



FIG. 3.



FIG. 4.

Fibrosis in the alveoli supplied has taken place and later necrosis, as seen in fig. 4.

We have never seen anything parallel to this in pneumokoniosis due to other dusts, nor have we been able to find such occurrence in literature.

On comparing these large particles with asbestos dust there is a striking resemblance in sizes, shapes and colour. In fact it is very easy to take each single particle found in lung sections and immediately find its brother in a slide made from the dust.

We cannot think there is any reasonable doubt that the particles in the lungs are the heavy, brittle, iron containing fragments of asbestos fibre. The more extensive involvement of the right lung is thus explained. The heavy particles would pass more easily down the more vertical right bronchus than the horizontal left bronchus. The third feature of the sections is the presence of the bodies shown in figs. 5 to 8. They are found in alveoli, bronchioles, fibrous and necrotic areas, and in phagocytes in sections of both lungs, but

again, chiefly in the right. They are yellowish brown in colour and do not stain with the usual stains, but give the prussian blue reaction. There is a uniformity in appearance, group distribution (figs. 5 and 6), and fructating heads (figs. 7 and 8) that make one think of a fungus. The hyphæ



FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.

are verruciform and discoid, and definite spores are seen. Many cases are recorded of infections of aspergillus and penicillium occurring with tuberculosis. We have submitted sections to mycologists, bacteriologists, comparative pathologists, botanists and others, and the opinions obtained are

surprisingly varied. Some are very confident that the bodies are not vegetable, others that they are radiolaria spicules, and some, diatomaceae. "Casts of small cavities" are suggested, and again, that they are particles of asbestos fibre that have become coated with colloidal matter.

On the other side we have equally definite opinions that the bodies are fungoid. Cultures were unobtainable because the lungs were in formalin when received, and without cultures it is impossible to classify the fungus, but on morphological grounds it has been suggested that the organism is an aspergillus, a penicillium, or a hyphomycete with septate hyphæ similar to that described by H. H. Scott (1926) in batrachians.

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DESCRIPTION OF FIGURES. •

- Fig. 1.*—Asbestos fibre showing black angular particles. $\times 150$.
Fig. 2.—Asbestos dust. $\times 150$.
Fig. 3.—Asbestos particles in fibrotic area of lung. $\times 150$.
Fig. 4.—Asbestos particle in necrotic area of lung. $\times 150$.
Figs. 5 and 6.—Fungoid bodies in lung sections. $\times 400$.
Figs. 7 and 8.—Fungoid bodies in lung sections. $\times 1,000$.

XIII.—THE PREPARATION AND EXAMINATION OF COAL SECTIONS.

By JAMES LOMAX, F.R.M.S.

(*Read May 18th 1927.*)

THE purpose of this paper is to draw attention to the importance of the microscope as an instrument of investigation in the many problems to be met with in the coal-mining industry, and to show what use can be made of preparations of coal and the associated matter found therein, including petrifications. Many papers have been given from time to time and published in the Journal of this Society, notably one on the "Structure and Origin of Carboniferous Coal Seams," by E. Wetherhead (1885).

Most of the illustrations in this paper were taken from thin slices of coal composed mainly of spores, micro-and-megaspores. From such one is led to believe that coals are chiefly the products of spore-bearing plants. Parts of some seams are admittedly so, but the majority consists of a series of zones, composed of a variety of plant remains, other than those derived from Lycopodaceous plants.

ELL COAL, FROM NEWDEGATE COLLIERY.

Transparent slices of coal, cut progressively to show the various bands and laminae of the seam from floor to roof, show that the nature of the constituents at the bottom of the seam are totally different from those at the top, or in the middle. The bottom portion is composed of the remains of finely laminated plant debris, consisting of thin almost structureless bands alternating with bands composed of a leaf like humus, small resinous bodies, a few megaspores, in a matrix of microspores and other structureless substances. This condition exists for several inches in the vertical plane. Many of the above-mentioned thin bands are obviously the remains of small twigs or stems, for in many cases excellent wood structure can be detected. Ascending in the seam the spore exines increase in number until finally the whole substance is composed of nothing more than the microspores forming the matrix, in which the megaspores are embedded and appear in the vertical plane as small flattened sack-like bodies, and in the horizontal plane as more or less circular disc-like bodies, each of which is ornamented with external appendages of various forms according to the species. The whole then forms a bed of more than one foot in thickness, and from this point the spores begin to decrease in quantity, until the coal substance is similar in composition to the lower part;

it also contains thin bands and small lenticles of argillaceous matter, in which, with high magnification, large numbers of bacterial remains may be seen.

The above is not an isolated case, but is general throughout the coal measures, although the spore exines may not be so prolific in any particular seam. There is always a general succession of ingredients which are, as a rule, visible to the naked eye, forming bands, some bright and brilliant, others vitreous, pitch-like and brittle, or soft, sooty and fibrous.

The above ingredients are named so that they can be conveniently described, the first being known as *Clarain*, on account of its brightly banded appearance in the block, and from its clearness when examined under the microscope. Generally *Clarain* is composed of a variety of constituents, including resinous bodies, fragments of plant tissues, and a few spores.

The second is known as *Vitrain*, being more or less vitreous looking. When examined microscopically it appears to be structureless, although frequently well-defined plant tissues can be traced, the remains of some stem or fragment of a large trunk. Very often such bands may be traced a considerable distance in the seam, or they may be in small lenticles. If in the first form they probably represent the plant tissues in longitudinal section, and if in the latter in transverse section. *Vitrain* may also occur in various forms, being the product of very highly broken down plant remains, which originally formed a vegetable pulp or slime similar to dopperolite, frequently found in recent peat deposits.

The third ingredient is known as *Durain*. This is frequently found to be very dull and contains a considerable amount of ash, in which case it contains some foreign matter, probably of secondary origin; when clean it is composed of little else but spore exines, the largest bulk being megasporos. Therefore it may be classed as a spore-coal. When *Durain* is found at its best it is used extensively as a steam and household coal. It is usually hard and tough, weathers very well, and will stand rough usage in transport.

The fourth ingredient is *Fusain*, formerly known as "Mother of Coal," "Soot," and "Smudge." It is soft and rarely solid; it soils the fingers when handled. Its appearance is similar to that of black rooted wood, it is always more or less fibrous, and is probably the broken down remains of the inner or outer cortical layers of stems. *Fusain* is frequently associated with pyritiferous matter, in which case it forms a substance which easily oxidises and is probably a factor in the initial cause of spontaneous combustion.

All the four ingredients can be met with in all seams, in varying quantities. A preponderance of one or the other alters the behaviour of the coal on carbonization, for the *Clarain* or *Vitrain* varieties give off a large amount of gas, but are altogether too fatty to make a good coke, and will, under some conditions, block up the retorts by swelling. *Durain* will not form a coke, but breaks up into breeze, and if a suitable

mixture with Clarain or Vitrain occur in a seam like the arley, a good coking and gas coal is the result. If the coals are artificially blended, the same results can be obtained. In any case a microscopical examination of coal seams gives a good idea of what will happen on carbonization of any particular seam.

Microscopical examination can be made by two methods :—

A.—Transmitted light.

B.—Reflected light.

In the case of examination by transmitted light, transparent slices or sections are used, and for examination by reflected light polished etched surfaces. Excellent results can be obtained from both methods, but where practicable a thin section offers advantages over the polished etched surface. In a material which constitutes several substances of varying degrees of hardness, great difficulty is often experienced in obtaining a perfectly polished surface for etching, as the softer ingredients are more readily ground away, leaving the harder portion standing out in relief. Etching a specimen of this description is also an operation presenting difficulties, as the reagents will act violently on some parts of the surface and leave others untouched. If the material is composed of particles cemented together by a vitreous matrix the edges of the particles are not always easily distinguished, and if the cementing material is removed by means of some chemical reagent, it may also affect the particles to some extent, so that a really true surface is not always shown. In thin sections these difficulties do not arise, as such fine polishing and etching of the surface is not required. In the examination of compact products, such as coal, by thin sections, the constituents are retained in their relative positions, and all features which depend upon disposition and interaction are most effectively investigated. Another great advantage of examination by this section is that polarised light may be used. By this means the structure and nature of organic remains may be seen. Information may be gathered which will lead to more efficient utilization.

In the making of a series of sections of the whole thickness of a seam, it is necessary to obtain a complete column of coal so that a series of blocks can be cut of a suitable size for manipulation in the laboratory. From this both vertical and horizontal sections can be cut of a suitable size, each block being lettered progressively from floor to roof, as the floor part represents the portion of the plant debris naturally deposited first.

It is a well-known fact that no means are available for preparing transparent slices from very large pieces of coal, and although we are able to produce probably the largest section ever obtained for ordinary purposes, it is necessary to limit the size of the pieces of coal which are being examined. The seam is therefore divided into more or less natural zones, and each zone is cut into blocks, the size of which is most convenient for the purpose

of producing satisfactory thin slices. Each block is lettered and numbered according to the original partings, sometimes a seam may have a natural zone, about 12 in. in vertical thickness. This natural zone is divided usually into two blocks, in certain cases three or four blocks would be made, the size being dependent upon the individual character of the particular zone. If the zone consists of strong coherent coal, the blocks would be considerably larger than if the coal were composed of soft and fragile material. In the latter case it would be necessary to cut three blocks of the natural zone. These blocks are made by numbers in the natural order from floor to roof, thus A1 and A2 are the artificial sections into which the natural zone A has been divided, in order to make it possible to obtain the most satisfactory thin sections of the seams. The system here described is applied to every section of a seam, and includes fire clays and dirt bands.

The size of the blocks most convenient for ordinary purposes is 3 in. by 3 in. but in special cases they are made as large as 3 in. by 8 in.

MANIPULATION OF THE BLOCK OF COAL PREPARATORY TO THE CUTTING OF A THIN SLICE.

As a general principle it is found that only exceptional coals are strong enough to withstand the manipulation necessary for the preparation of thin slices, which necessarily includes the grinding and polishing of the coal. Most coals undergo considerable disintegration and become broken into dice-like pieces. When the coal contains zones of soft fragile dirt bands or clay the material may fall into powder or slack, and the bone-like material into slate-like flakes. Such disintegration is prevented in the author's laboratory by the use of a special binding solution, made by dissolving bleached or pale shellac in methyl alcohol (wood naphtha). The solution is made of varying concentrations to conform to the type of coal under examination, and has proved to be not only a most effective cementing material, but also a preventative against the absorption of water by the more cellular and porous parts of the coal substance.

The proper application of the cementing material is largely a question of the experience of the operator, and it is not possible, without undue elaboration, to give any clear idea of the variations of treatment required by coal possessing different degrees of cohesive power.

THE TERMS "FACE" AND "END."

It is necessary to differentiate clearly the direction in which the coal is being obtained from a seam. In the majority of cases there are three distinct directions in which the coals may be split up when being worked :—

The first is along the bedding planes which are parallel to the floor and roof.

The second along the cleavage planes, the direction of which is generally at right angles to the dip of the seam.

The third in the "end" which is more or less at right angles to the "face."

The "face" or cleavage planes are found in a more pronounced form when under the influence of considerable earth movements. Many of the lines of cleavage, and consequently the cleavage faces, are covered with a deposit of ankerite, i.e. calcium carbonate, in which a portion of the calcium is replaced by another metal, frequently pyrites. When the coal is being wrought it falls from the seam in large flaky masses, generally breaking at one of the cleavage faces. At right angles to this plane is the "end" of the seam, in which the coal is broken without influence of the line of cleavage.

When the bedding planes of the seam are practically horizontal, a difference will be noticed between either the "face" and the "end." This is more pronounced in the case of soft coal. It is probable that most of the cleavage planes may be ascribed to the construction of the coal substance, and where tough beds or bands are present, the face is never so clearly developed as in the case of bright and soft coal.

It will be gathered from the above that if a preparation is required from a block which is made up of a large number of cleavage planes, greater difficulty will be experienced in making the preparations from the face, owing to the flakes of material continually breaking away from the block of coal.

It is our usual practice, on this account, to cut most of our preparations from the "end" of the coal, and thus overcome the pronounced difficulties experienced when the coal has a distinct cleavage. Where the coal has few cleavage planes, and is consequently not prone to break into conical pieces, little difference will be experienced in making a preparation either from the "face" or the "end."

It is essential for the preparation of first-class sections that such disintegration should be prevented. The author has paid particular attention to this subject, and has carried out extensive tests with a view to keeping the coal substance in a complete and compact form, the investigations having included the examination of most of the best methods previously used.

The second feature of importance in the preliminary preparation of the coal is the fact that all coal contains occluded gases in a greater or lesser degree. As is well known, the volume of gas present varies with the type of coal, and it is desirable that sections should be cut as soon as possible after the coal has been mined, in order to retain its original characteristics.

It is a well-known fact that the greatest volume of gas is evolved when coal is crushed, and it follows that during the cutting of coal in the preparation of thin slices there is a tendency for the occluded gases to be given off; further as it is necessary for the coal to be heated during the manipulation, the evolution of the gas is all the more pronounced. If,

however, the coal is given a preliminary heating to a temperature higher than that used in the actual mode of preparation, then it follows that practically no evolution of gas would occur. In other words, unless the temperature is raised to a few degrees higher than that used in the actual manipulation a further column of occluded gases will be liberated. As will be seen later, the coal is mounted on a glass slip, and a medium is used having the consistency of glue. If the evolution of gas mentioned above occurs, innumerable small gas bubbles will be produced between the glass slip and the block, as the preparation is cooled to the temperature of the atmosphere. If this happens it is impossible to produce a satisfactory section.

The third feature is the moisture present in the coal, and that with which the coal comes into contact during the actual cutting of the section.

The action of the latter moisture is eliminated, and its further influences prevented by the method of preparation which it is now proposed to describe in detail. It will be seen in the course of this description that the coal is completely covered with a layer of shellac, and that the moisture is entirely removed from the coal before the preparation of a section is attempted.

The following is a brief description of the method of treatment of the cut block preparatory to slicing. The block of coal which has been cut to the required size is placed in a bath containing a solution of bleached or pale shellac in wood naphtha, it is completely covered with this preservative material, which prevents the absorption of water in its subsequent treatment. The face of the coal from which the preparation is to be made is now ground perfectly flat, thus removing the upper shell containing the preservative and exposing a fresh untouched face of coal. In grinding the coal as little water as possible should be used in order that as little as possible may come into contact with the fresh surface. The block is now freed from all superfluous impurities, dirt, etc., and is then dried by placing in a water-jacketed oven. The temperature of this oven is raised to about 200° F., and the block is maintained at this temperature for four or five hours. The treatment ensures the complete removal of the water from the coal. The block is then removed, and placed face downwards in a flat bottomed metal dish, into which have been placed narrow strips of glass to raise it from the dish bottom. A sufficient quantity of shellac solution is now introduced into the dish, until the block is immersed to a distance of about $\frac{1}{2}$ in. The dish and its contents are now returned to the oven, and heated to 170° F. This treatment ensures the complete saturation of the face of the coal with the shellac solution. The coal, which is distinctly porous, absorbs the shellac, and at the temperature mentioned above the methyl alcohol present is gradually evaporated. When the above treatment is completed the blocks are removed from the dish and allowed to cool.

The next stage is the process of preparing a perfectly level surface on the block, which is absolutely free from blemishes or scratches. The method consists of rubbing down the surface on a piece of plate glass, using

carborundum powder as an abrasive. When the surface has received this preliminary treatment it is polished with a suitable razor, wet-stone or putty powder, using water as a lubricant. The surface of the block is now ready for mounting.

MOUNTING THE PREPARED BLOCK.

A number of difficulties are associated with this part of section cutting, mainly concerned with the fragility of the coal substance. The polished coal face must in the first instance be made to adhere to the glass slip on which it is mounted, and secondly from there has to be cut a thin slice without any part of the coal face becoming detached. Many adhesives have been suggested, and usually solid canada balsam is used in the mounting and cutting of hard rock and mineral specimens. In the preparation of coal sections this adhesive is not suitable owing to the degree of softness and brittleness, to the fact that it will not adhere to the coal substance, and that it is readily scratched and, during the last stages of thinning, loosened from the glass.

For preparations of a small size the above adhesive material may be used, but for large preparations it was necessary to discover a more perfect medium. The author has experimented with many mixtures of balsams and resins, with a view to satisfying the requirements necessary for cutting large coal sections, namely: that the material should be tough, hard and not easily scratched, and at the same time should be colourless and capable of adhering to both glass and coal. A mixture of two ounces of specially selected gum copal crushed into a fine powder and mixed with six ounces of liquid canada balsam, forms a suitable adhesive material. The method of preparation consists of mixing two gums and heating the mixture slowly over a sand bath until it attains a sufficient degree of hardness when cooled. Special care is required during the heating in order to prevent discoloration of the mixture. The mixture when cooled should be hard, and yield no impression when indented with the finger nail.

By varying the proportions of the two gums the degree of hardness of the resulting mixture may be modified. Thus, by increasing the proportion of gum copal the hardness is increased, and at the same time the melting point of the mixture is raised so that additional heating is required in order to soften the adhesive, and to spread it over the glass slips preparatory to mounting the specimens. The addition of the correct amount of gum copal by thus increasing hardness and toughness of the mixture makes it possible for the right consistency to be maintained at the temperature which is required for mounting the specimens, in order to inhibit the evolution of gas from the block of coal. It has been found that the most efficient temperature at which to maintain the mounting medium is from 220° to 230° F. In mounting blocks of coal the specimen should be heated to a minimum amount, and if possible no heat at all should be used, and until the method to be described

later was evolved it was found that occluded gases were given off when the coal was pressed into the molten medium, frequently resulting in a volume of gas bubbles being formed between the glass and the block of coal.

In mounting ordinary rock specimens it is usual to heat the specimen so that the polished face will adhere to the mounting medium. If this is omitted a most imperfect connection is made between the specimen and the glass slip. If the specimen is not heated when the polished face comes into contact with the molten mounting medium, the sudden cooling of the latter causes a grey film (non-adhesive) to be formed between the mounting medium on the glass slip and the cool face of the specimen, allowing in the subsequent operation the specimen to peel off the glass when it is being manipulated to obtain a thin slice.

The above consideration applies in dealing with blocks of coal, in which it has been found essential to mount the specimen as cold as possible. This is necessary because the specimens tend to evolve their occluded gases. To avoid this the face is covered with a thin film of oil, the best being the oil of cloves.

METHOD OF HEATING THE GLASS SLIPS.

With a view to obtaining the greatest evenness during this part of the preparation, the method of heating the glass slips must be chosen with great care. The following method is the one used by us :—

A cast-iron plate, 12 ins. square, is placed 8 ins. or 9 ins. from one end over a straight Fletcher Burner, so that one part of the plate is about 1 in. above the flame. This ensures one portion of the plate being at a high temperature whilst the opposite edge is at a considerably lower temperature. This allows the glass slips covered with balsam to be heated to above the melting point, of the latter, and by moving them to the opposite edge of the plate, gradually cooled until the balsam is of the right consistency for mounting the specimen.

METHOD OF MOUNTING THE BLOCK OF COAL.

The hot plate is raised to about 250° F., and a glass slip of ground or polished glass of the requisite size and thickness is placed on the hottest part. A piece of the mounting medium (gum copal and balsam) is now rubbed over the hot surface until the slip is covered to the depth of about $\frac{1}{8}$ in. The glass slip is now drawn to the cooler part of the plate. The block of coal on which the polished surface has been prepared is now covered with a thin covering of shellac and allowed to become perfectly dry, and just preparatory to mounting the surface of the block, is covered with a thin layer of oil of cloves. When the glass slip is at the requisite heat, the block is put face downwards on to the slip covered with the adhesive material. This operation must be carried out expeditiously and an even pressure should be exerted. This

operation should be carried out as soon as possible after the coal has been placed on the glass slip, in order to obviate as completely as possible the heating of the coal. As indicated earlier in this report, the block is now pressed on to the glass slip by weights and allowed to remain until completely cool.

FIXING AND HOLDING THE BLOCK PREPARATORY TO CUTTING A THIN SLICE.

When the block of coal has been attached to the glass as described above, the next operation is that of cutting a thin slice. The cutting tool is generally a hacksaw, and it is necessary for the coal to be fairly clamped in a specially constructed vice. The vice we use consists of two boards 3 ft. 6 ins. long by 6 ins. wide, attached by a broad iron or leather hinge, and bored at a distance of 9 ins. from the other end by $\frac{1}{2}$ -in. holes, into which is fitted a long threaded $\frac{3}{8}$ -in. bolt with winged nut. At the mouth of the vice should be glued a thin sheet of rubber, on the bottom side of which is screwed a thin strip of wood $\frac{1}{8}$ in. by $\frac{3}{4}$ in., which passes across the full width of the board. On the other jaw a similar piece is fixed at right angles, so that the two form a recess into which the glass slip attached to the mounted block will fit. This vice is fitted to a table having the hinge practically on the floor level. The chief advantage of this form of vice is that any size of block may be dealt with. Before the jaws are finally clamped upon the coal, a narrow leather or india-rubber strap should be placed between the bottom edge of the block and the back board so that the former is held in position.

CUTTING THE PREPARATION.

In cutting thin slices of ordinary rocks a copper or soft iron disc is generally used, charged with either diamond dust or fed with carborundum or emery powder. Such methods of cutting are of little use for coal, in view of the fact that the coal substance is cellular and spongy in nature. When the coal substance contains fortuitous impurities such as calcite, veins of petrifications, ironstone, pyritic matter, etc., such cutting discs may be adopted. In order that a lapidary cutting disc should be efficient the specimen must be harder than the material from which the cutting disc is made, for when the disc is charged with diamond dust in the ordinary way it will be ineffective unless the hard substance of the rock presses the harder particles of the abrasive into the edge of the soft metal of which the disc is made.

After long continued experiments we have come to the conclusion that the best methods of cutting coal is by means of an ordinary hack saw, using blades $1\frac{1}{2}$ ins. wide and 1 ft. 3 ins. in length, with ten teeth to the inch. It is our practice to sharpen the saws ourselves so that the face of each tooth is absolutely square. By having blades and teeth cut in this manner the actual cutting effect upon the coal is brought about by a forward thrust, there being no cutting on the backward stroke. It is necessary to point out

that this method of cutting is a greater economy of labour and time than the more laborious process of grinding or thinning down the preparation.

THE THINNING OF THE PREPARATION.

When the preparation has been cut as described above, the next process consists of reducing the above section until it becomes transparent and sufficiently thin for microscopic examination. In our experience only one efficient method of thinning coal preparations is available, though in the course of time most other methods have been suggested and tried. For coal it seems the grinding can only be performed efficiently on a cast-iron disc fed with carborundum powder. The laps we use are generally 12 ins. in diameter, 1 in. in thickness, and are mounted on a vertical spindle so arranged that the disc revolves horizontally in a water-tight shallow vessel about 9 ins. deep. Carborundum powder mixed with water is applied to the lap as it is running. The grinding is generally done in three stages on three different laps, the first or coarse grained is when the preparation is still thick, in the second the preparation is comparatively thin, and in the third the preparation transmits light at various points.

Considerable skill is required in the latter stage, and the slightest carelessness or an attempt to make the preparation especially thin may lead to the whole thin slice being swept off the glass in an instant. The later stages of the operation must be done by hand, for it is impossible to grind any section of coal to the requisite thinness by machinery. This is done on a piece of plate glass using extra fine carborundum powder until the section becomes transparent, and finally finished off on a retouching frame, that is to say any suitable apparatus on which the preparation can be laid, so that light can pass through from behind. Here great care must be taken, as many hours' work may be spoiled through one false slip. In many cases banded coals may, according to their density and opaqueness, be required thinner in some bands than in others, and to obtain this soft pieces of fine razor stone are used, with water as a lubricant. Some of the pieces of stone may be less than $\frac{1}{2}$ in. in diameter and others much larger. These are held by the fingers and rubbed on the surface of the preparation until the constituents are of the requisite thinness.

In many instances, especially in soft coals, no abrasive stones are used, only pieces of cloth held between the fingers.

It may be gathered that the above operation is most delicate, therefore it is only time and practice that can make the worker perfect.

COVERING AND FINISHING THE PREPARATION.

The final operation is the finishing off and covering. After the preparation is thinned the superfluous mounting medium is cleared from the edges of the section, the glass slip cut to the requisite size, in most cases 3 ins.

by 8 ins., the edges of the slip being ground and polished. Afterwards a suitable cover glass is prepared, and the preparation cleaned. A suitable mixture of hard balsam and benzene is prepared, which, when cold, will set fairly hard, heated almost to boiling-point, and kept ready on the hot plate. The preparation is taken in the hand and smeared with oil of cloves, slightly warmed and covered in the centre with a spoonful of the prepared balsam. The cover glass, which has been slightly warmed, is then removed from the warm plate and pressed firmly on to the preparation, squeezing out at the same time the superfluous balsam.

The cover glass should be firmly pressed all the time, being treated with caution until the benzene has had time to evaporate; afterwards the balsam is left as a hard film between the cover glass and the preparation. The superfluous balsam may now be removed from around the cover glass by means of a heated knife, or, better still, a razor. The whole is then cleaned by the usual method of washing in petrol and afterwards in dry soap and water.

The above description of the various methods and operations in the making of coal sections is that in operation in our laboratories at Bolton, where large numbers of sections are made each year. A word of warning must be given. Only by intelligence and practice can a good and successful coal section be made of a comparatively large size.

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XIV.—OTOLITHS OF LARGE EELS FROM THE RHINE.

By A. GANDOLFI HORNYOLD, F.R.M.S., F.Z.S.

(Read May 18th 1927.)

ONE PLATE.

At the meeting of this society on October 21, 1925, a paper on "Otoliths of Large Eels from the Albufera of Valencia" was kindly read for me in my absence and published in the March number, 1926. Last autumn Dr. W. Schmassmann, Inspector of Fisheries of the canton of Basel, kindly sent me the heads of four large silver female eels, captured on October 30th in the Rhine, on Swiss territory, at the electrical power works at Augst.

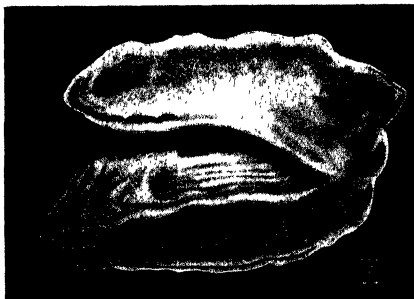
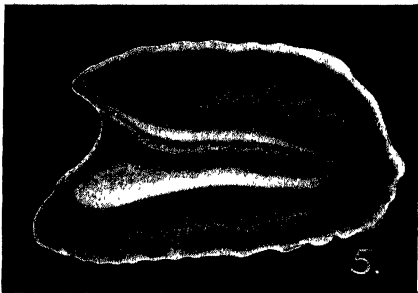
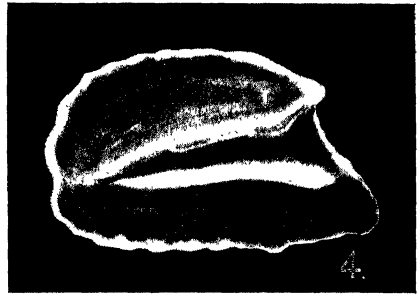
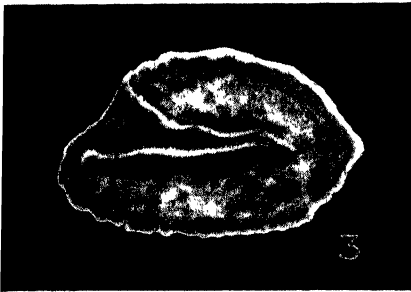
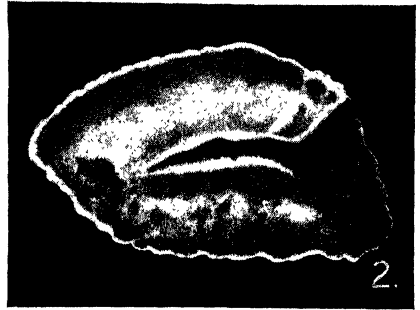
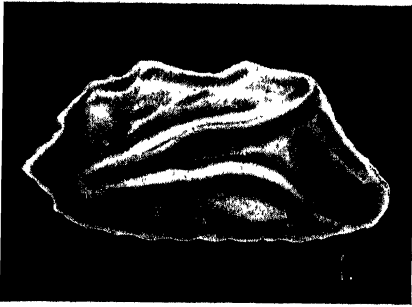
The following table gives the length, weight and dimensions of the saccular otoliths of these eels. Unfortunately the right otolith of the 122 cm. eel was lost.

Length cm.	Weight gr.	Dimensions of Otoliths mm.	
122 . .	4,150 . .	Left	6.0 × 3.00 ; right
95 . .	1,800 . .	„	4.0 × 2.75 ; „ 4.25 × 3.0
90 . .	1,600 . .	„	4.5 × 2.75 ; „ 4.25 × 3.0
84 . .	800 . .	„	4.5 × 3.25 ; „ 4.00 × 3.0

The table confirms my previous observations. Usually both otoliths are of the same size, but they can also differ more or less. In the present case the otoliths of the 84, 90 and 95 cm. eels all differ slightly. The left otolith of the 84 cm. eel is the largest otolith of the three eels. As said before, the size of the otolith is not in absolute proportion to the length of the eel. Naturally the otoliths of a 122 cm. eel would be longer than those of an eel of 84 cm. long. The left otolith of the 122 cm. eel measures 6 by 3 mm., which is 1.5 mm. longer than any of the other otoliths, but three other otoliths measure also 3 mm. across !

The drawings were made by Don Adhímar Lopez y Mechó, student of the medical faculty of Valencia, in the Spanish Hydro-biological Laboratory, using a Reichert binocular microscope, with a 50 mm. objective and eyepiece 4, which gives a magnification of 27.

The left otolith of the 122 cm. eel (fig. 1) is elongated, the dorsal rim curved and indentated, the ventral rim straight, and the posterior rim ends in a point with a notch above and below. There is no antirostrum or excisure, and the rostrum is large and rounded. The undivided deep, oblique sulcus opens out very widely on the front rim, covering it completely. The sulcus ends rounded at about seven-eighths of the length of the otolith. There



OTOLITHS OF EELS FROM THE RHINE.

is a ridge on part of the dorsal side. The left otolith of the 95 cm. eel (fig. 2) is elongated, the dorsal rim is curved, the ventral straight, and the dorsal rim forms a rounded protuberance. There is no antirostrum or excisure, and the rostrum is obtuse. The undivided sulcus opens out widely on to the front rim, covering nearly the whole of it. The sulcus is deep, narrow, and curved, ending in a point about two-thirds of the length of the otolith. The form of this otolith is very similar to that of fig. 10 in my previous paper, representing the left otolith of a 97 cm. eel from the Albufera of Valencia. The form of the sulcus, however, is quite different.

The right otolith (fig. 3) is elongated, the dorsal rim is curved, the ventral nearly straight, and the posterior rim forms a point. There is no antirostrum or excisure, and the undivided straight sulcus opens widely on to the front rim, ending in a point at about three-quarters of the length of the otolith. The left otolith of the 90 cm. eel (fig. 4) is elongated, the dorsal rim is curved, the ventral straight, and the posterior rim is rounded, forming a very slight protuberance in the centre. The antirostrum is small and obtuse, and the rostrum is large and rounded. An excisure is present. The undivided straight sulcus opens out widely on the dorsal part of rostrum, and ends in a point at about six-sevenths of the length of the otolith. The right otolith (fig. 5) is elongated, the dorsal rim is curved, the ventral straight with a few indentations, the posterior rim is also rounded, and forms a slight protuberance. The antirostrum is large and obtuse, the rostrum is large and rounded. An excisure is present, and the straight undivided sulcus opens out widely on to the dorsal part of rostrum, ending rounded at about seven-eighths of the length of the otolith. The sulcus has a ridge on the dorsal side.

The left otolith of the 84 cm. eel (fig. 6) is elongated, the dorsal rim is curved and indentated, the ventral rim is very slightly curved, and the posterior rim is straight. The rostrum and antirostrum are large and rounded. An excisure is present. The very wide, shallow, curved and undivided sulcus opens out widely on to the rostrum, covering it completely, and ending in a point near the posterior rim. The sulcus is very uneven near the front rim, forming several mounds. The right otolith of the 84 cm. eel (fig. 7) is elongated, the dorsal rim is curved and indentated, the ventral rim is straight, and the dorsal rim ends in a point above the sulcus. The rostrum and antirostrum are large and obtuse. An excisure is present. The wide undivided straight sulcus opens on to the rostrum, covering it completely and ending in a point at about six-sevenths of the length of the otolith. The sulcus slopes down very gradually on the ventral side, forming various ridges, but on the dorsal side there is only one ridge.

My previous observations showed that there is not only a very considerable differentiation in the form of otoliths of large eels, but that in the same eel each otolith may also show more or less differentiation in the general form, in the form of the sulcus, or in both. These observations confirm those made on otoliths of large eels from the Albufera of Valencia. All of these otoliths differ, more or less, either in general form, or in that of the

sulcus, or in both. If we compare figs. 2, 3, 4, 5, 6 and 7, it is obvious that in the same eel each otolith shows also more or less differentiation in form, in that of the sulcus, or in both. The otoliths of figs. 1, 2 and 3 have no antirostrum or excisure, and those of figs. 4, 5, 6 and 7 are more or less of the cluproid type. 122 cm. and 4.150 kgr. is a very large size for an eel, approximately 50 inches and 9 pounds. No doubt this eel was of a considerable age, but I was not able to examine any scales. These otoliths of eels from the Rhine had many fewer indentations and crystallisations than those of the eels from the Albufera.

XV.—NOTE ON A METHOD OF STAINING AND CLEARING THE MUSCULAR SYSTEMS OF CRUSTACEA.

By R. J. DANIEL, M.Sc. (Dept. of Oceanography,
University of Liverpool).

(Read at the LIVERPOOL CONFERENCE, March 1927.)

IF smaller types of Crustacea are cleared in methyl salicylate they become very transparent, so that it is difficult to trace the muscles and impossible to dissect them out under the binocular microscope. During an investigation upon the abdominal muscular system of the common shrimp (*Crangon vulgaris*) the writer has evolved a method which, while utilising the clearing properties of methyl salicylate, also demonstrates the muscles in coloured transparency, and since trial has shown this method to be applicable to other small Crustacea, a description of it is given below.

In the case of the shrimp, animals were taken which had been preserved for some time in 70 p.c. methyl alcohol and had therefore lost their natural colour. This avoided the removal of pigment by the use of hydrogen peroxide or other bleaching agent, a task which is not easy with Crustacea.

Before dehydrating in absolute alcohol, the shrimps were divided in sagittal section by means of a safety razor blade; this facilitated subsequent dissection, but was not necessary to the clearing process. The objects were transferred to a 0.05 p.c. solution of benzoquinone in absolute alcohol and left over night. After this treatment the muscles showed little colour, but upon immersion in a mixture of equal parts of absolute alcohol and methyl salicylate, they assumed a delicate rosy hue as the tissues began to clear. The specimens were finally transferred to methyl salicylate, and in this medium the clearing was completed.

The resulting preparations were of the greatest assistance in working out the muscular system, particularly the intricate system of the abdomen. Although the chitin was transparent, the outline of the animal was still discernible. Only the muscles stood out in relief, and these were a beautiful transparent red colour, with each fibre clearly picked out.

Thorough dehydration is necessary for complete clearing and to aid in this phenol (carbolic acid) may be added to the alcohols. With the shrimp the presence of phenol may actually improve the colour reaction.

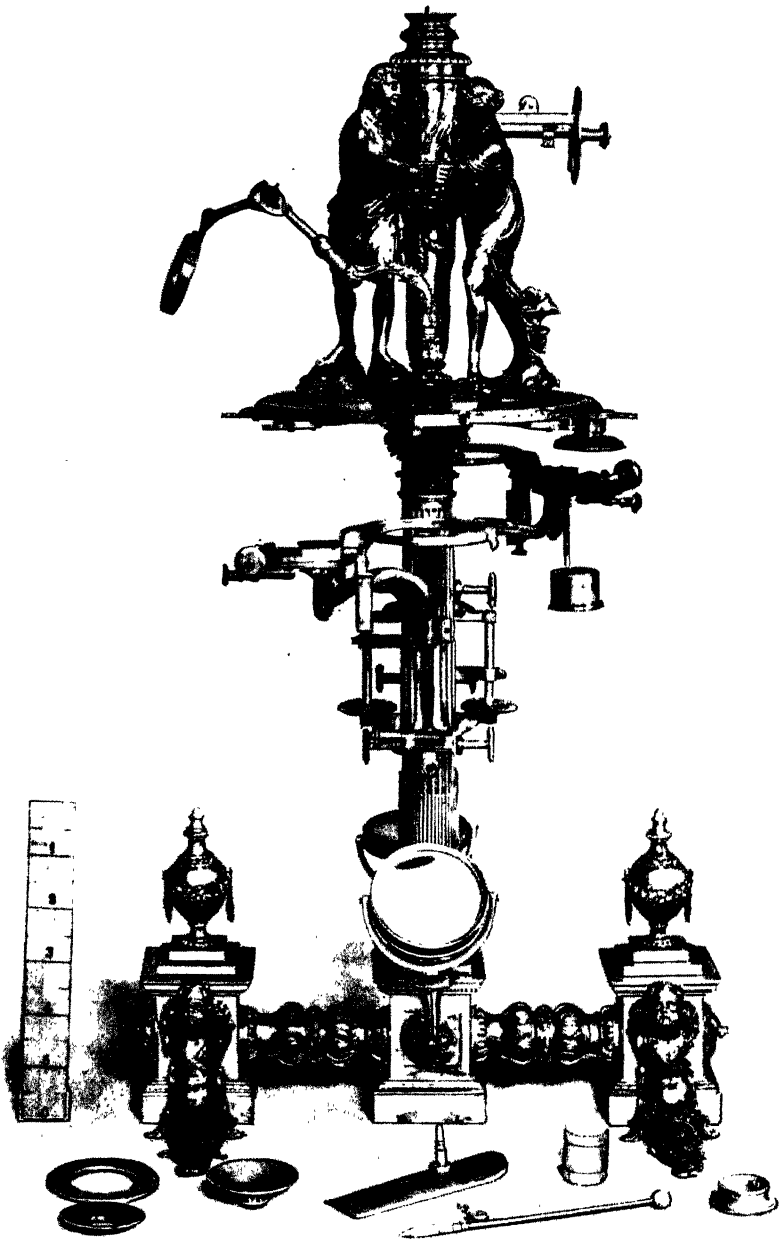
The method has been tried also with *Mysis*, *Nyctiphanes* and *Gammarus*, and with the same strength of solution the colour is not so marked as it is in *Crangon*. This is due in part to the greater bulk of muscle in the latter, but there are also individual differences in reaction to the stain, since in *Nyctiphanes* the colour is less apparent than it is in *Mysis*. It is not possible

therefore to lay down definite rules for optimum results with all Crustacea, this being a matter for experiment as the need arises.

The system adopted in brief is :—

1. Use of specimen from which pigment has been removed, either by long immersion in 70 p.c. alcohol, or by leaving overnight in concentrated perhydrol (Merck.)
2. *Thorough* dehydration in absolute alcohol.
3. Immersing specimen overnight in a freshly made 0·05 p.c. solution of benzoquinone in absolute alcohol. If perhydrol has been used it heightens the colour reaction and therefore the solution of benzoquinone needs to be weaker.
4. Gradual bringing up of specimen to a final clearing in methyl salicylate.

A second method of clearing which has been successful with the shrimp depends upon the use of oil of cinnamon. After the treatment described above, the animal may be transferred directly from the methyl salicylate to cinnamon oil, or it may be dehydrated and passed through different strengths of absolute alcohol and oil, immediately after fixation. In both cases the muscles take on a brown colour which renders them conspicuous under the low power binocular microscope, and the medium is an excellent one for dissection for those who do not find the smell from it objectionable.



SILVER MICROSCOPE MADE FOR KING GEORGE III BY GEORGE ADAMS IN 1761.

XVI.—TWO MICROSCOPES MADE BY G. ADAMS FOR KING GEORGE III.

By REGINALD S. CLAY, D.Sc., and THOMAS H. COURT.

SUPPLEMENTARY NOTE.

ONE PLATE.

By the courtesy of Messrs. Stevens & Co., and with the kind permission of Sir John Findlay, Bart., the present owner, we are able to give an illustration of the large silver-cased microscope previously described (Clay and Court (1926)).

This microscope exhibits the sacrifice of usefulness to ornament. Though perhaps the most artistically and elaborately decorated instrument ever constructed, Adams must surely have been fully aware of its faults as a scientific instrument, as for instance the combination of the single and compound microscopes in one instrument. It is necessary either to bend across the one to reach the other or to illuminate the object from the side, while the compound body is inconveniently close to the head when using the simple microscope. It is too high for table use and it cannot be inclined. In fact, if compared with the earlier "Prince of Wales" model illustrated in Plate XXII, in the *Journal of the Royal Microscopical Society*, December 1926, its scientific inferiority is such that one is forced to the conclusion that it was never really intended for serious practical work.

From the user's point of view, little can be said in its favour in spite of the beauty and excellence of its workmanship. It is nevertheless of great interest as a sign of the value which King George III attached to science. Throughout his long reign this interest was sustained and his collection of scientific instruments has recently been placed in the Science Museum at South Kensington.

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CLAY, R. S. and COURT, T. H. (1926).—*J. Roy. Micr. Soc.*, 46, 268.

OBITUARY.

ARTHUR BOLLES LEE.

It is with much regret that we have to record the death, on March 3rd, of Arthur Bolles Lee. He was born at Coldrey, near Alton, in Hampshire, in 1849, and spent most of his life in Switzerland. Although his name is very familiar to every worker in microscopy, he was personally unknown to the majority of workers in England.

As the author of the "Microtometist's Vade Mecum: a Handbook of the Methods of Microscopic Anatomy," he will always be remembered. The first edition appeared in 1885, and at once became the standard work of reference on the subject. It contained an account of all the methods which at that time had been recommended for the preparation of microscopic objects, including all the satisfactory methods of fixation, clearing, embedding, section cutting, staining and mounting of both organisms and tissues.

The value of this work of reference has long been recognised, and no biological laboratory can be considered complete without it.

In subsequent editions—of which seven appeared in England, up to 1913—Bolles Lee was careful to eliminate older and less satisfactory methods and replace them with accounts of more recent and approved processes in microscopic technique. In all cases the author gives full references to his source of information.

There have been several continental editions of the work, and the latest English edition (1921) was edited by Prof. J. Brontë Gatenby, of Trinity College, Dublin.

Mr. Lee was the author of a number of papers chiefly on cytological subjects, some twenty titles being given in the Catalogue of Scientific Papers, 4th series (1884–1900). His last paper appeared in the Quarterly Journal of Microscopical Science for December, 1924, on "The Chromosomes of *Paris quadrifolia* and the Mechanism of their Division."

In recognition of his services to the practical work of microscopy he was elected to an Honorary Fellowship of this Society.

ALBERT DAVIDSON MICHAEL.

By the death of A. D. Michael, at the advanced age of ninety-one, amateur microscopists have lost an old and distinguished friend. Born in London in 1836, he was educated at King's College, and afterward succeeded

his father in practice as a solicitor. It was after his marriage in 1865, and due largely to his wife's influence and ability, that he took up microscopical studies seriously, and he published his first paper in 1875 on a species of *Acarus*, believed to be new to Britain, in the *Journal of the Royal Microscopical Society*, having been admitted a Fellow in the previous year. Thereafter he made frequent contributions upon the *Acarina*—the group of organisms he made his special study—and soon became a recognised authority upon this group. He subsequently published, through the *Ray Society*, his monograph in two volumes on the *British Oribatidæ* (1883–1888), and a further two volumes on the *British Tyroglyphidæ* (1901–1903). In 1898 he communicated a masterly contribution to “*Das Tierreich*,” on a revision of the *Oribatidæ* of the World. In all his scientific work his wife assisted him with great ability, and her death in 1909 deprived him at an advanced age of his most devoted and competent observer and fellow worker.

He was elected President of the *Quekett Microscopical Club* (1885–1887), and of the *Royal Microscopical Society* (1893–1896), and in 1919 he was elected an *Honorary Fellow* of the latter Society. He also served on the Council of the *Linnean Society* as *Vice-President* (1896–1900).

Besides his scientific and professional interests, he was actively engaged for some forty years as *Agent and Secretary* for *Mid-Surrey* of the *Central Conservative Registration Society*, but failing health, and the loss of his wife, compelled him to relinquish his many interests, and he spent the latter years of his life in retirement at his beautiful home at *Studland* near *Swanage*.

C. T.

A PICTOGRAPHIC REVIEW.

MITOCHONDRIA AND CELL INJURY.

By G. M. FINDLAY.

AN attempt has here been made to envisage pictographically the changes occurring in mitochondria as the result of cell injury. Although much experimental work has been carried out on mitochondria, both under physiological and pathological conditions, the very multiplicity of functions with which they have been credited reveals the fact that their true purpose in the economy of the cell has not yet been determined. The following facts, however, are definitely established :—

(1) Mitochondria are widely distributed in the cells of animals and plants ; they are not however present in all living matter, for their existence is doubtful in the schizomycetes, the myxomycetes, and in most of the algæ.

(2) Although the refractive index of mitochondria is low, they can usually be seen in the living cell. They can be observed in tissue cultures, and may be in the form of rods, filaments, granules, or more rarely, interlacing networks. Observations of single mitochondria show that they readily change their shape from rods to granules or *vice versa*. The reasons for these changes of shape are unknown.

(3) Mitochondria stain characteristically with Janus green B in dilutions as weak as 1 in 500,000. They also stain with Janus blue and with the sodium salt of diethyl safranin monocarboxylic acid which is formed from Janus green by hydrolysis of the nitrile.

(4) Chemically mitochondria are composed of mixtures of protein and lipin. The proportion of these two constituents probably varies in mitochondria in different types of cell, while the variations which are known to occur under normal conditions in morphology, solubility and staining reaction may point either to differences in the chemical nature of the protein and lipin or to differences in the character of the surrounding cytoplasm.

(5) Mitochondria react very readily to certain types of cell injury.

Whether the changes which occur in mitochondria as the result of injuries to the cell are due to direct action on the mitochondria or to changes produced in the cytoplasm is unknown. The changes which do occur are of the following character :—

- (a) Qualitative.
- (b) Quantitative.
- (c) Topographical.

In determining changes in mitochondria great care must be taken that the fixative has penetrated uniformly throughout the tissue, and that the stain has been differentiated to the same extent in both control and experimental material.

(a) Qualitative Changes.

The most common change in shape is a transformation of rods into granules. This occurs in many pathological conditions, though the reverse process is exceptional.

In tissue cultures M. R. and W. H. Lewis (1915) showed that the form of mitochondria could be altered by varying the osmotic pressure of the fluid medium surrounding the cells. With hypotonic solutions the mitochondria increased in size, with hypertonic they decreased. In the body it is doubtful if changes in shape can be regarded as due to variations in osmotic pressure, since the osmotic pressure of the blood is relatively constant, while within certain plant cells pressures as high as thirteen atmospheres are developed. Occasionally, probably as the result of poor fixation, one end of a rod-shaped mitochondrion may become swollen or globular. Frequently, as the result of pathological processes, the mitochondria become granular and then disappear entirely—the process known as chondriolysis. In other cases they appear to swell up to form fat or lipid globules. It is uncertain whether transformation of active mitochondria into fat globules actually takes place, or whether the regions occupied by mitochondria are merely centres where fat appears in the cytoplasm. Sometimes the mitochondria seem to agglutinate to form large lipid globules.

It is noticeable that though qualitative changes can readily be produced by pathological conditions in gland cells, yet in the cells of the central nervous system there is no evidence of qualitative change in such conditions as fatigue, poliomyelitis, botulism or herpetic myelo-encephalitis.

(b) Quantitative Changes.

The importance of counting the mitochondria in unit areas has been emphasized by Thurlow (1916 and 1917), for the possibility of changes in cell volume must be taken into account in determining an apparent increase or decrease in the number of mitochondria. Thus Rasmussen (1921) as the result of accurate volumetric studies of the cells of the woodchuck has shown that there is no quantitative change in the mitochondria during hibernation. During embryonic and adult life the number of mitochondria remains fairly constant for the particular type of cell, but as old age comes on the number gradually decreases. Cowdry (1918) has figured occasional cells showing a complete absence of mitochondria, though whether these cells are really normal it is impossible to tell. On the other hand, apparently normal cells may occasionally contain a greatly increased number of mitochondria. The quantitative variations which occur under physiological

conditions make it extremely difficult to interpret variations which may be found under pathological conditions. This is especially the case when human material is obtained at operation or at autopsy, for not only is it impossible to examine adequate controls, but in the case of post-mortem material autolytic changes may seriously interfere with a correct interpretation.

Although a reduction in the number of mitochondria, as the result of chondriolysis is common, an increase is not so frequently found. Homans (1915) has recorded an increased number in the islands of Langerhans in diabetes, while a number of observers have noted it in conditions of extreme activity in the thyroid gland. An increased number of mitochondria has also been found in the kidney after the administration of phloridzin or in regeneration, though according to Oliver (1916) it is not found in regeneration after uranium nephritis.

Feeding lecithin to plant cells is said by N. H. Cowdry (1920) to increase the number of mitochondria, while Russo (1912) states that in chickens fed with lecithin the number of mitochondria in the ova is also increased. Up to the present this interesting observation does not appear to have been confirmed.

(c) Topographical Changes.

Changes in position within the cell are by no means rare. In tissue cultures it is not uncommon to observe individual mitochondria passing from the nuclear region to the periphery of the cell and back again, though the reasons for these movements are unknown. In many tumour cells there may be both a peripheral and a perinuclear grouping, while in sulphonal poisoning there is a very characteristic margination. In *Colpidium colpodu* Mottram (1926) has recorded a loss of the typical striated arrangement as the result of exposure to β radiation. Possibly these changes in position are due not to the mitochondria themselves but to cytoplasmic currents set up by the imbibition of water.

The variations observed in mitochondria as the result of pathological conditions throw little or no light on the functions of these bodies. It seems not unlikely, however, that as first suggested by Regaud (1909), the surfaces of mitochondria are the loci of synthesis in the cell, thus playing a part similar to that of the plastids in plant cells. Brailsford Robertson (1926) further points out that the lipid composition of these bodies would tend to orient molecules at their surfaces in such a manner that the reactive groups, the carboxyl and α amino groups of amino acids, would all point towards the aqueous phase, while the lyotrope hydrocarbon chains would be buried in the lipid phase. The movements of the molecules would thus be restrained and confined in rotation around the axis of the hydrocarbon chain, so that the reactive groups would attain an effective concentration at the surface of the aqueous phase, which could not possibly be attained in any other manner.

In this connection it is interesting to note that Joyet-Lavergne (1927) has recently found that mitochondria are coloured by sodium nitroprusside. It is therefore possible that they represent the cell areas in which the auto-oxidisable substance glutathione is concentrated.

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* Denotes that the paper has been abstracted pictographically.

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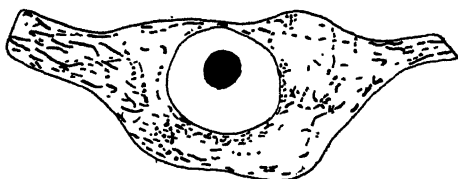
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FIGURES.

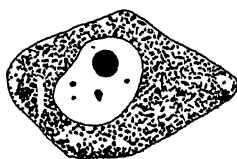
NOTE.—All figures have been drawn to scale, but have been reduced by two-thirds in reproduction with the exception of Fig. 8, which has been enlarged two and one quarter times.

Figs. 1-7. Physiological variations in mitochondria.

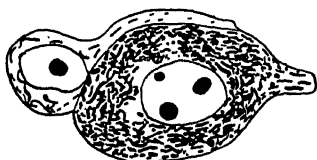
Figs. 8-81. Pathological variations in mitochondria.



Large anterior horn cell of
spinal cord.



Cell of Grassierian ganglion.



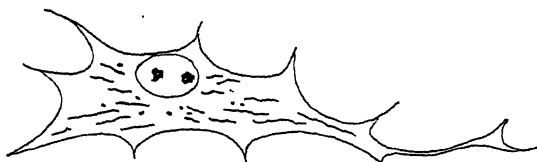
Large cell of the mesencephalic nucleus of
5th nerve with a cell of the
locus caeruleus.



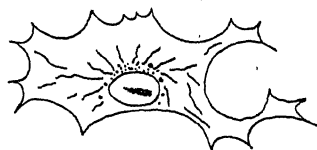
Cell from the corpus trapezoideum.

Morphological variations in mitochondria
in the nerve cells of the mouse.

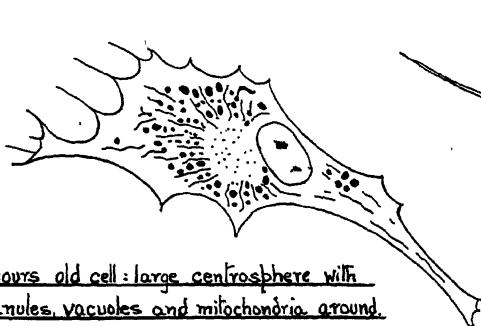
FIG. 1.—Normal variations in the mitochondrial content of the nerve cells of the mouse.
After N. C. Nicholson (1916).



Healthy fibroblast with a few scattered granules.



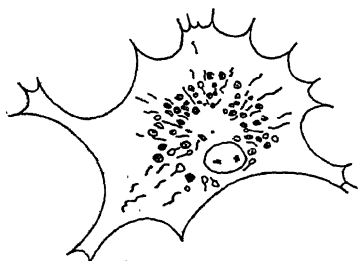
Radial accumulation of granules and mitochondria round the nucleus



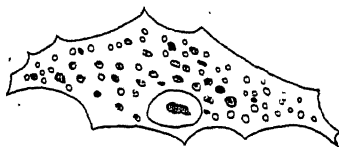
78 hours old cell: large centrosphere with granules, vacuoles and mitochondria around.



2 day old culture.



3 day old culture: mitochondria changing into vacuoles.



Degeneration of mitochondria: a decrease in the number of neutral red vacuoles.

Fibroblasts from tissue cultures of chick embryo showing the relation of mitochondria, granules, vacuoles, centriole, centrosphere and nucleus.

FIG. 2.—After W. H. Lewis (1919).

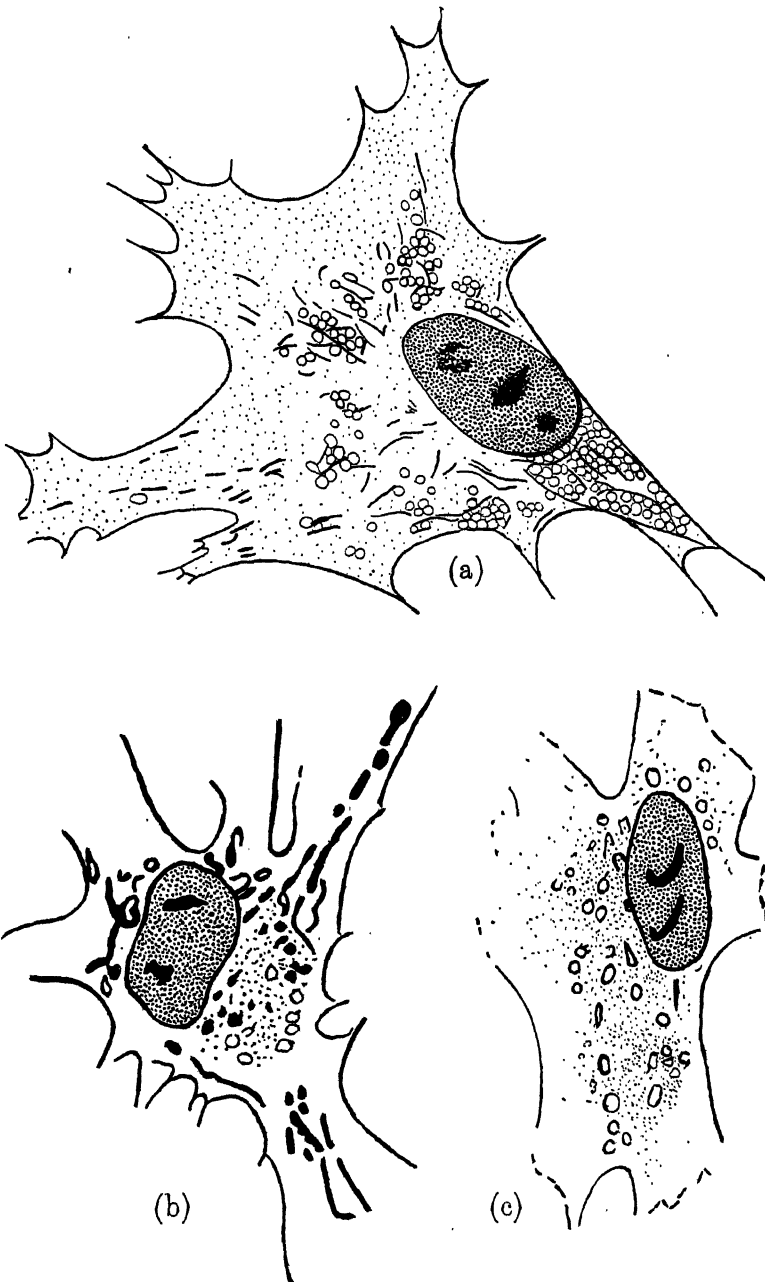
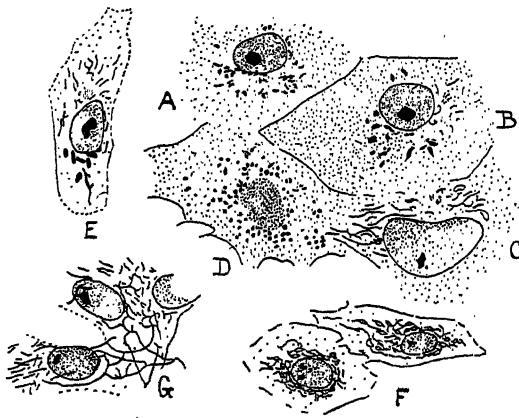


FIG. 3.—(a) Mitochondria and fat globules, (b) and (c) gradual degeneration of mitochondria in fibroblasts from 2 days tissue culture of chick embryo heart.
After M. R. and W. H. Lewis (1915.)



Morphological variations in mitochondria of fibroblasts
cultivated "in vitro."

FIG. 4.—After M. R. and W. H. Lewis (1915).



FIG. 5.

Meristem, young and old cortical cells of the pea showing : (A) primary diffuse arrangement of mitochondria ; (B) secondary condensation about the nucleus and (C) final dispersal throughout the cytoplasm.

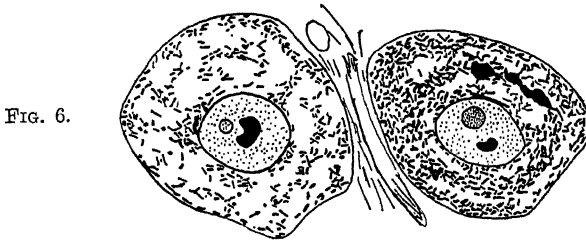


FIG. 6.

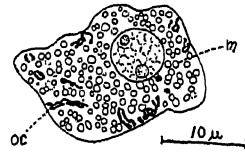
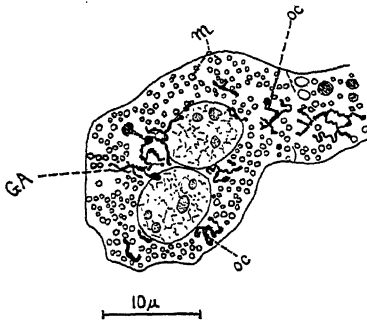
Morphological variation in the spinal ganglion cells of the pigeon.



FIG. 7.

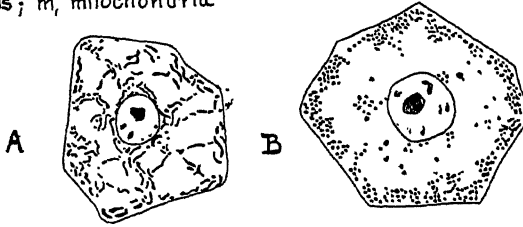
Apparently normal cells devoid of mitochondria.

FIG. 5.—After N. H. Cowdry (1917).
FIGS. 6 and 7.—After E. V. Cowdry (1918).



Cell from liver of mouse: bile duct tied 1 hour before death.

Cells from the liver of a mouse injected with insulin. oc, osmophilic canaliculi; GA, Golgi apparatus; m, mitochondria



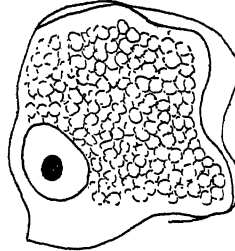
Cells of Rabbit liver; A normal: B sulphonal poisoning.

FIG. 8.—After W. Cramer and R. J. Ludford (1926).

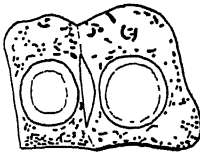
FIG. 9.—After E. Grynfeldt and R. Lafont (1921).



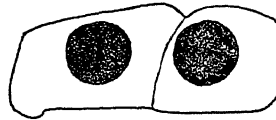
The effect of enclosure
in an air-tight space
for two days.



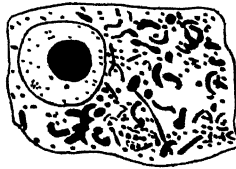
The effect of exposure
to chloroform vapour for
 $2\frac{1}{2}$ minutes.



The effect of exposure to
ether vapour for $2\frac{1}{2}$ minutes.



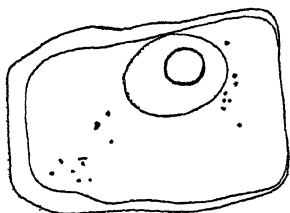
The effect of immersion in a
10 per cent solution of glycerine
for 18 hours.



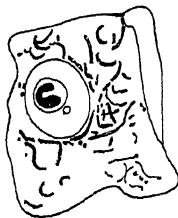
The effect of contact with a
one per cent solution of lecithin
for one day.

Experimental changes in the mitochondria
of plant cells.

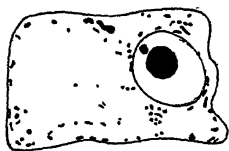
FIG. 10.—After N. H. Cowdry (1920).



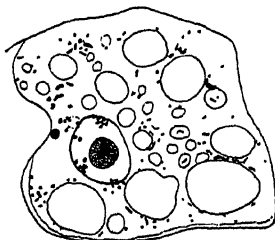
The effect of a temperature
of 65°-73°C for 40 minutes.



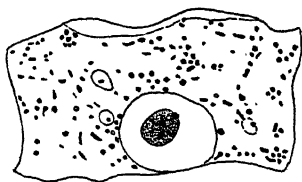
The effect of a temperature
of 10°C for 4 days.



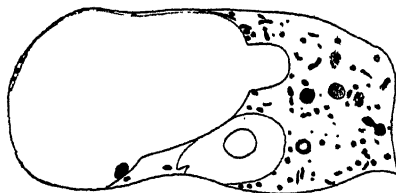
The effect of a temperature
of 10°C for 18 days.



The effect of a freezing
mixture of ice and snow.

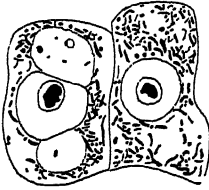


The effect of submersion
in water for 24 hours.



The effect of enclosure
in an air-tight space
for one day.

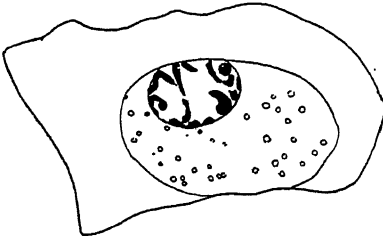
FIG. 11.—Experimental changes in the mitochondria of plant cells.
After N. H. Cowdry (1920).



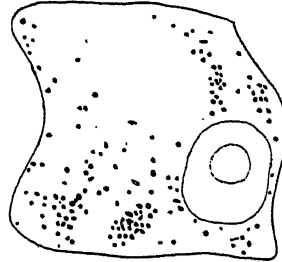
Normal cells of the cortex of the radicle of the pea near the meristem.



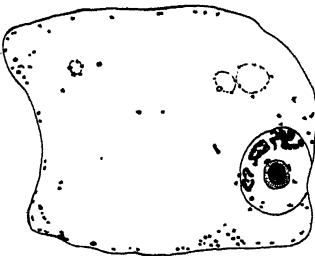
The effect of centrifuging for one hour.



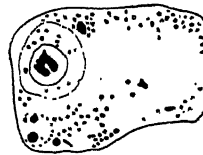
Plasmolysis caused by immersion of the radicle in a 20 per cent solution of cane sugar for two days.



The effect of drying for 36 hours.



The effect of a temperature of 43-46°C for three hours.



The effect of a temperature of 47-49°C for 30 minutes.

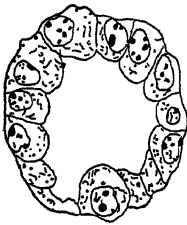
FIG. 12.—Experimental changes in the mitochondria of plant cells.
After N. H. Cowdry (1920).



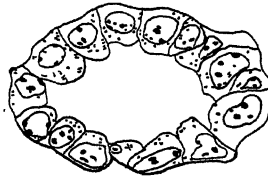
Mitochondria in Thyroid of
normal adult guinea-pig.



Number of mitochondria
reduced in old guinea-pig.



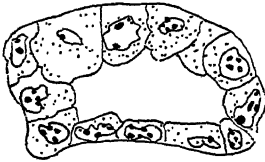
3 days.



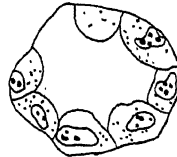
7 days.



10 days.



25 days.



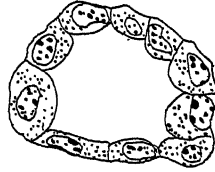
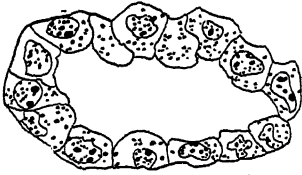
45 days.



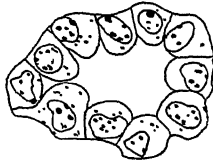
60 days.

Changes in mitochondria following ligation
of the large blood vessels.

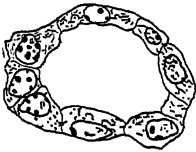
FIG. 13. — Experimental changes in the thyroid gland of the rat.
After F. M. Nicholson (1923).



Adrenalin injections.



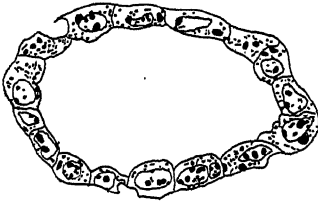
Pilocarpine injections.



Hydrogen cyanide - a lethal dose.



Hydrogen cyanide - repeated doses.



Phosphorus poisoning.

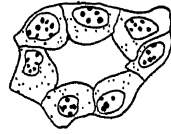
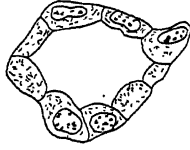


Mitochondrial changes in
the thyroid gland.

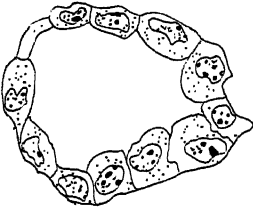
FIG. 14.—Experimental changes in the thyroid gland of the rat.
After F. M. Nicholson (1928).



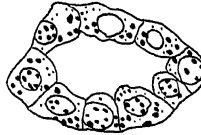
Removal of one and a half lobes: increase of mitochondria after 10 and 25 days.



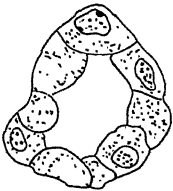
4 days feeding thyroid gland.



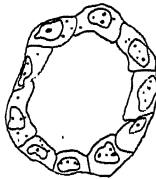
Injections of Potassium iodide for 25 days.



Starvation for 3, 4 and 6 days: fat droplets and decrease in mitochondria.



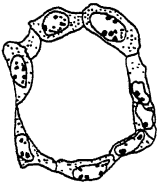
Normal rat thyroid.



Rat - vitamin B.



Rat dead 7 days.



The effect of breathing pure oxygen for nine hours.

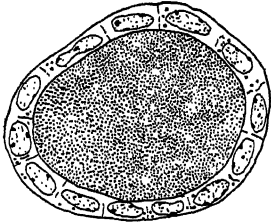


Partial asphyxiation.

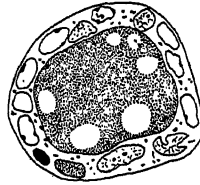


Atropine injections.

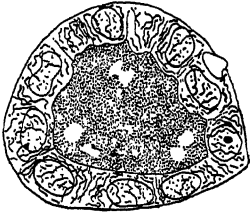
FIG. 15.—Experimental changes in the thyroid gland of the rat.
After F. M. Nicholson (1928).



Thyroid fed.



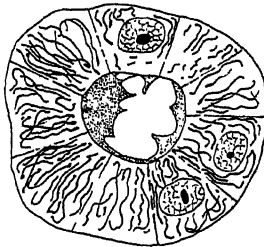
Exposure to heat.



Exposure to cold.



Fasting.



Action of β -tetrahydronaphthylamin.

Mitochondrial changes in the thyroid gland.

FIG. 16.—Experimental changes in the thyroid gland of the rat.

After W. Cramer and R. J. Ludford (1926).

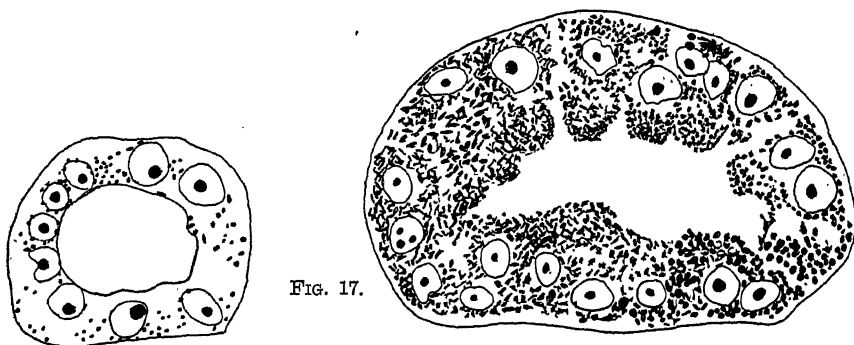


FIG. 17.

Normal thyroid.

"Foetal adenoma."

Mitochondrial variation in the thyroid
associated with a "foetal adenoma".

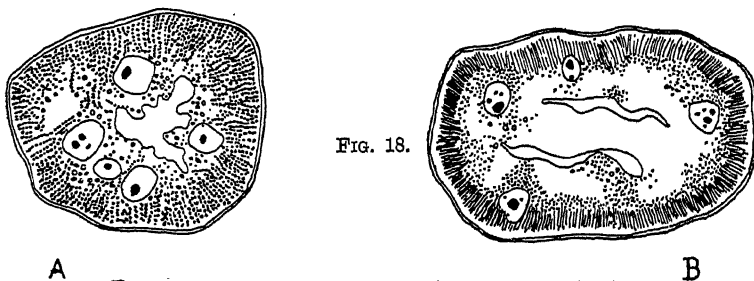


FIG. 18.

A

B

Effect of diuretics on kidney tubule
(A) Control. (B) After injection of them



FIG. 19.

A

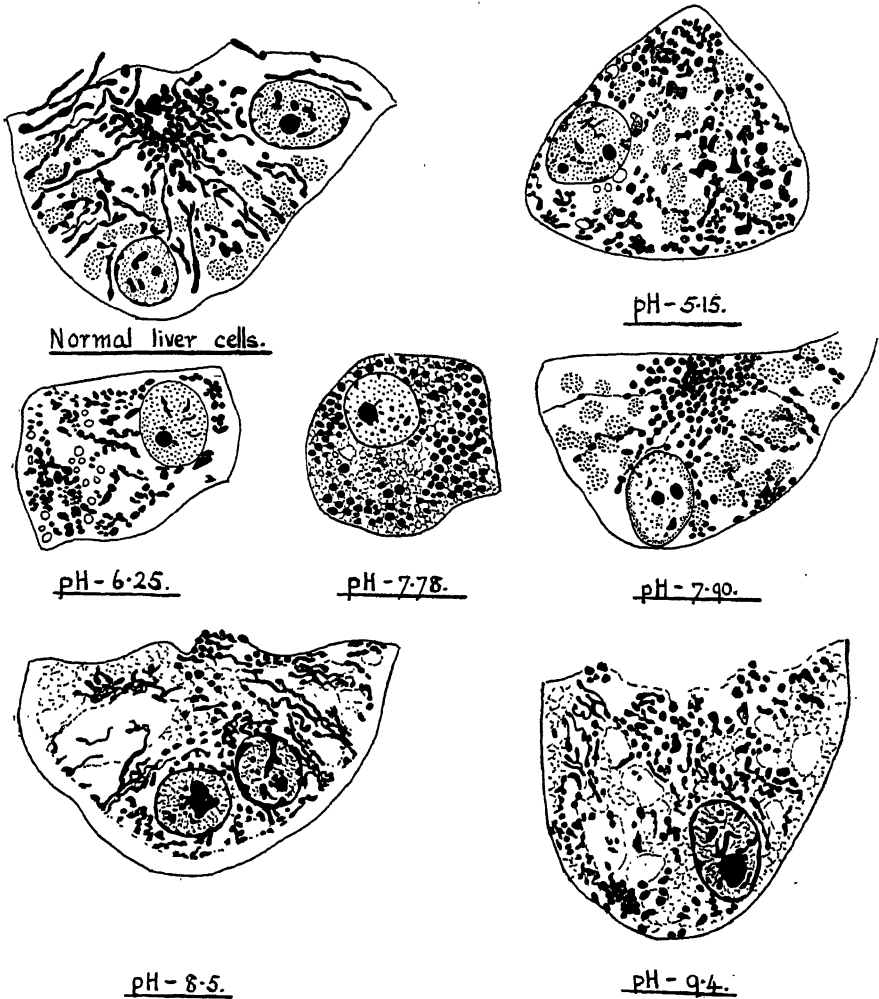
B

Rabbit Kidney. A, cell from convoluted
tubule prior to secretion; B in
severe haemoglobinaemia.

FIG. 17.—After E. Goetsch (1916).

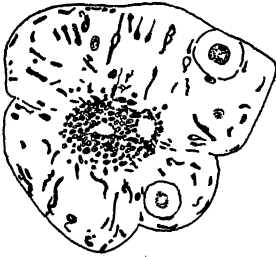
FIG. 18.—After K. J. Hjelt (1912).

FIG. 19.—After J. O. W. Barratt (1913).

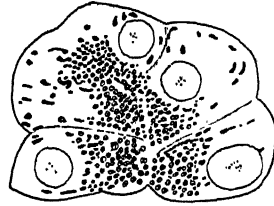


The effect on mitochondria in liver cells
of incubation in Ringer's solution of
varying hydrogen ion concentration.

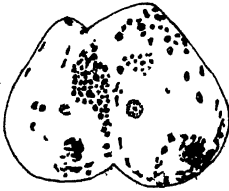
FIG. 20.—After A. Rumjantzew (1926).



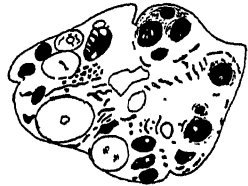
Acinus of normal mouse: mitochondria with bleb-like swellings: zymogen granules in distal parts of cells.



Early change: mitochondria shorter: no bleb-like swellings.



Later stage: clumping of mitochondria: decreased number of zymogen granules.

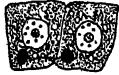


Fusion of mitochondria with formation of lipoid droplets containing vacuoles.

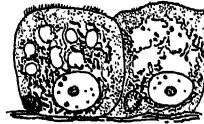


Fatty infiltration and lipoid droplets.

Experimental mitochondrial changes in the pancreas of the mouse in phosphorus poisoning.



Normal choroid
cells of rabbit.



Effect of pilocarpine



Chronic phosphorus
poisoning.



Chronic Arsenic
poisoning.



Infection with bacillus
melitensis.



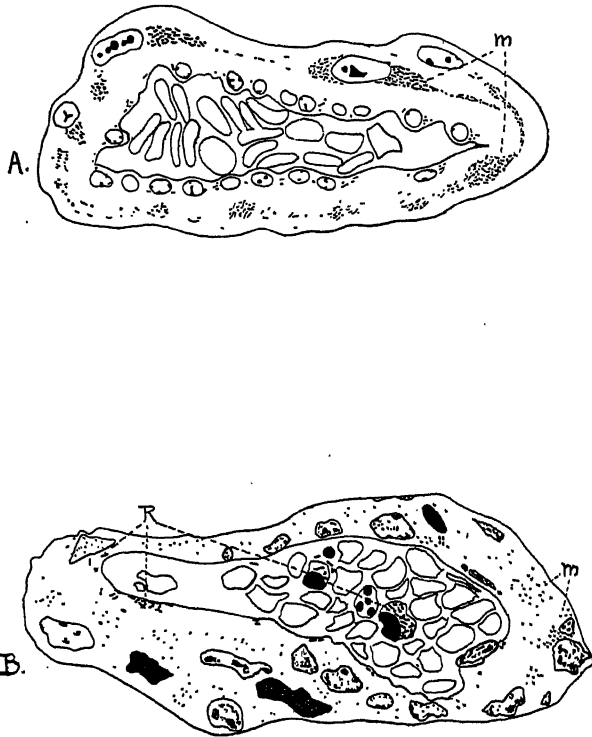
Diphtheria toxin.



Pulmonary tuberculosis
in man.

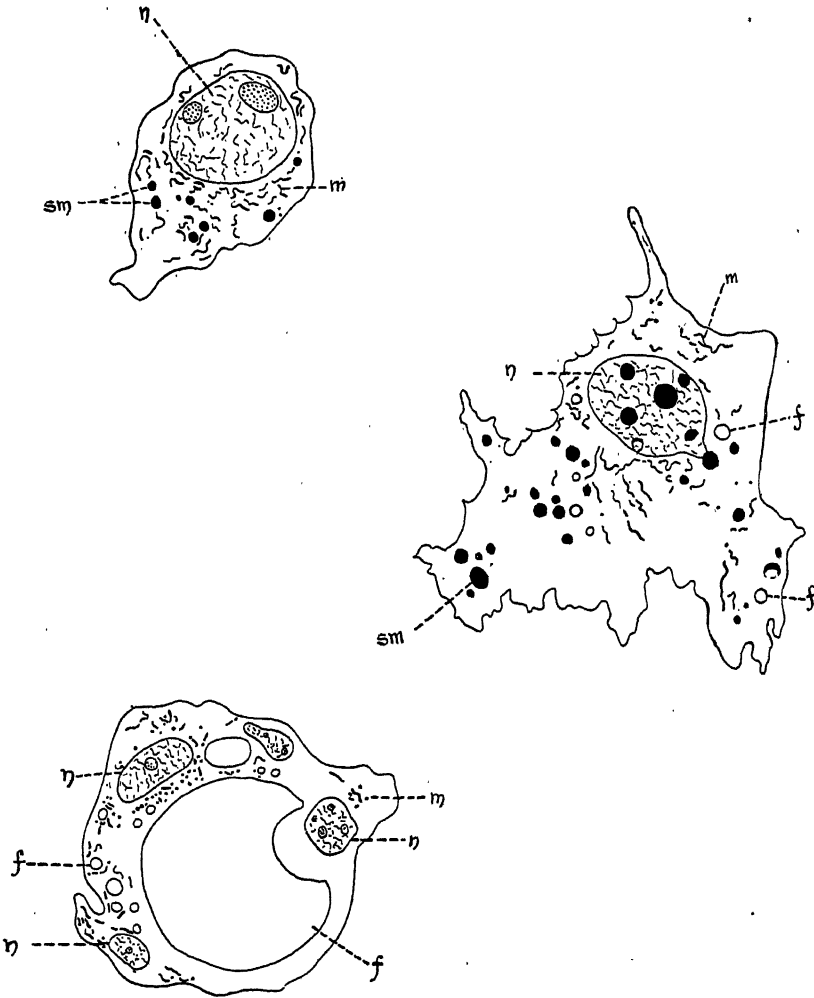
Mitochondrial changes in the
cells of the choroid plexus.

FIG. 22.—After C. Ciaccio and S. Scaglione (1913),



- A. Venule from a normal guinea-pig showing mitochondria-m.
- B. Venule from a guinea-pig infected with Rocky mountain spotted fever showing mitochondria-m and Rickettsia-R.

FIG. 23.—After F. M. Nicholson (1923).



A lipo-sarcoma of the guinea-pig.
 f-fat droplets; m-mitochondria; n-nuclei;
 sm - swollen mitochondria.

FIG. 24.—After J. A. Murray (1906).

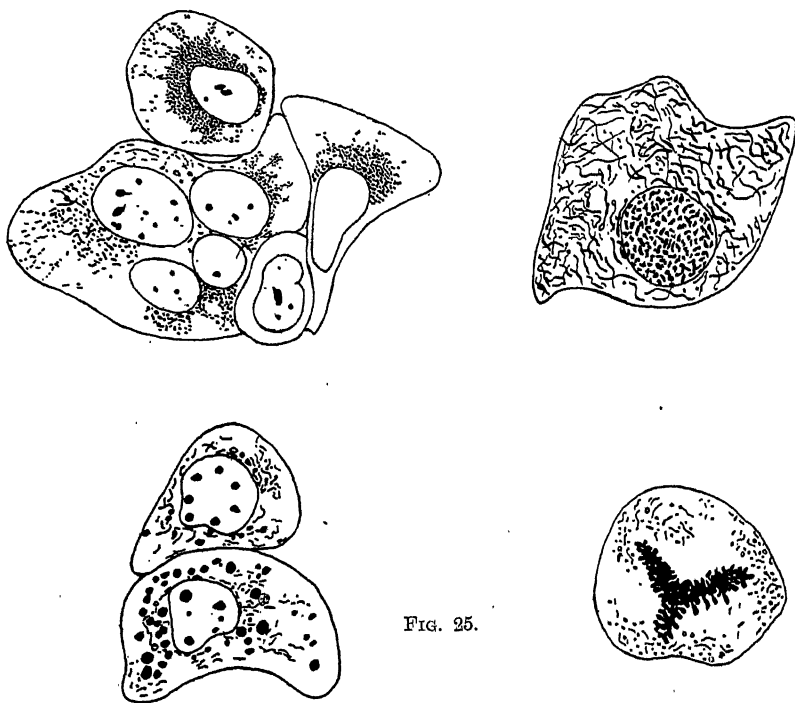
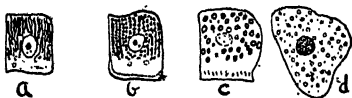


FIG. 25.

Mitochondria in carcinoma of
the breast in women.

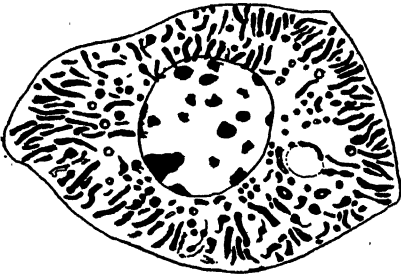
FIG. 26.



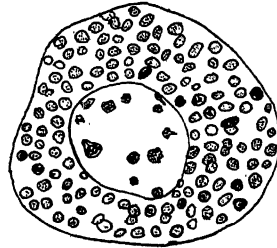
Cells from convoluted tubules of rabbit kidney. (a) normal. (b) given diphtheria toxin. (c) 18 hours and (d) 36 hours after the injection of 2 c.c. of *B. coli* culture.

FIG. 25.—After M. Favre and C. Regaud (1911).

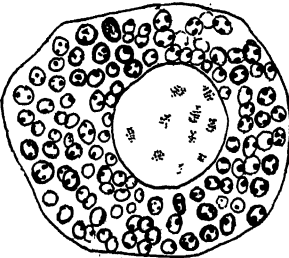
FIG. 26.—After C. Ciaccio (1918).



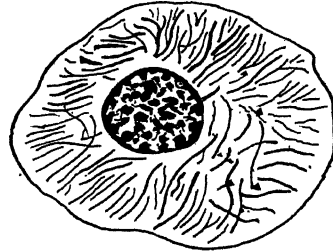
Axolotl: normal liver cell.



Swelling of mitochondria:
5-15 minutes in 0.1-0.2 per cent.
Sodium chloride solution.

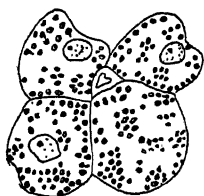


Granular swollen
mitochondria.
5-15 minutes in 0.1-0.2 per cent
Sodium chloride solution.

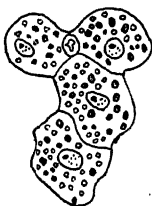


Thread-like mitochondria:
5-15 minutes in 0.8-1.0 per cent.
Sodium chloride solution.

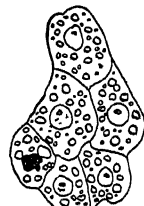
The effects of hypo- and hypertonic salt solutions
on mitochondria in the liver cells of Axolotl.



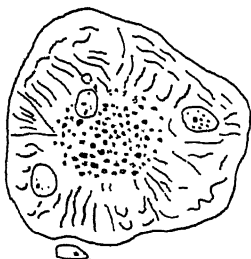
Rabbit liver. Normal



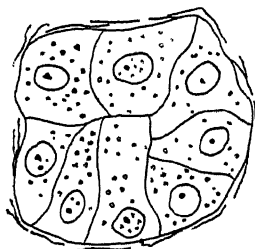
17 days' starvation



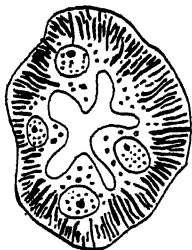
9 days' starvation.



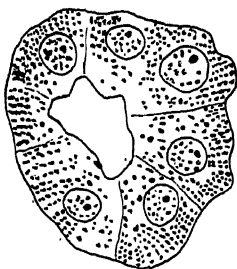
Rabbit pancreas. Normal.



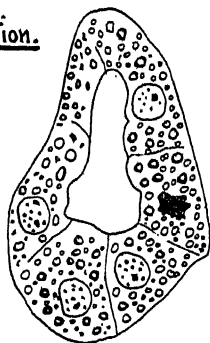
15 days' starvation.



Rabbit kidney. Normal.



11 days' starvation.



9 days' starvation.

The effects of starvation on mitochondria

FIG. 28.—After N. Okuneff (1923).

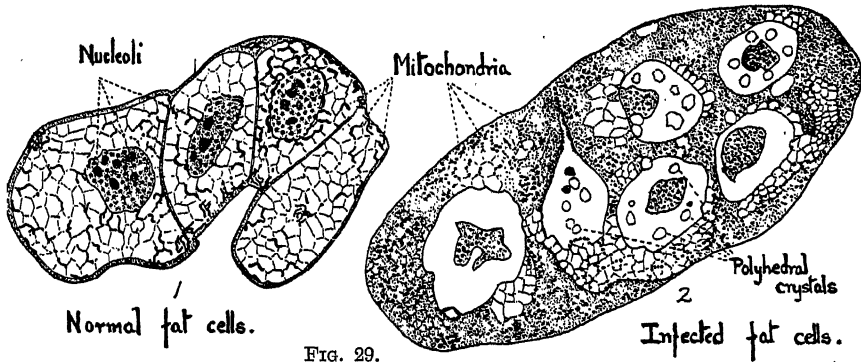
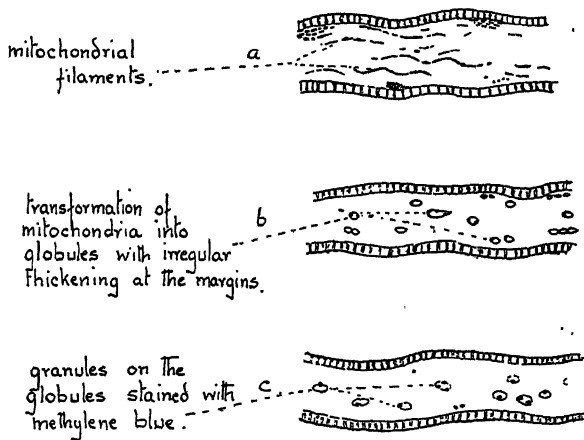


FIG. 29.

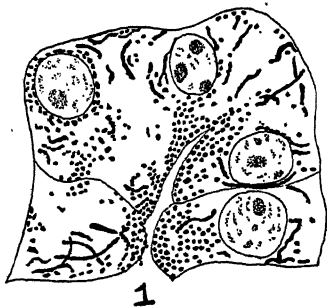
Fat cells of the Caterpillar of the Silk Worm Moth (*Bombyx mori*)
infected with the polyhedral virus.



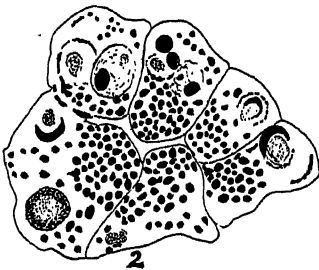
Stages in the development of Negri bodies in the
brain of the Rabbit.

FIG. 29.—After A. Paillot (1926).

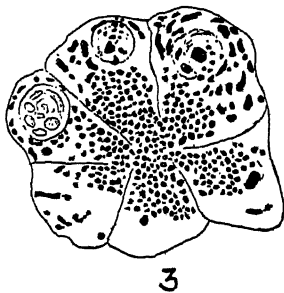
FIG. 30.—After H. W. Goodpasture (1925).



An acinus of a normal pancreas
of guinea-pig.



After twenty days' inanition.



After twenty days' inanition : a less
degree of change than in fig. 2.



Mitochondria are arranged parallel to
basement membrane : fat surrounded
by mitochondrial substance.

FIG. 31. - The effects of inanition on mitochondria in the pancreas of the guinea-pig.
After W. C. Ma (1924).

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- (1914).—"Alcune osservazioni sui condriosomi delle cellule cartilaginée nella coda del tritone rigenerante." *Anat. Anz.*, **45**, 459-474.
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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

STAINING AND IMPREGNATION METHODS.

Acid Fuchsin as a Stain.—J. T. SCANLAN, R. W. FRENCH and W. C. HOLMES (*Stain Technol.* 1927, 2, 50-55). From a study of 38 samples of acid fuchsin prepared from several types of basic fuchsin and under varying conditions it is found that rosanilin sulfonated between 80° and 85° C. gives the best results in the van Gieson staining technique. Staining tests also show that a satisfactory acid fuchsin will give the best results when employed with picric acid in the ratio of 1 part of the 1 p.c. aqueous acid fuchsin to 20 parts of the aqueous picric acid. Details for the preparation and use of acid fuchsin are given. G. M. F.

A Rapid Fat Stain.—F. PROESCHER ("Oil Red O. pyridin—a Rapid Fat Stain," *Stain Technol.* 1927, 2, 60-1). Oil red O is an azo dye formed by diazotation of amino-azo-xylene and condensation with β -naphthol. When dissolved in a 70 p.c. watery solution of pyridin it stains all fats more intensely and rapidly than Sudan III or Scharlach R. G. M. F.

Supravital Staining in Paraffin Sections.—L. U. GARDNER ("Preserving Supravital Staining with Neutral Red in Paraffin Sections of the Lung," *Proc. Soc. Exp. Biol. and Med.* 1927, 24, 646-648). A modification of McJunkin's method: The dye is injected either by the intravenous or intratracheal route. The tissues are fixed in an alkaline Zenker-formol solution. Dehydration is accomplished by 80 p.c. alcohol, followed by graded mixtures of 95 p.c. alcohol and benzene; finally the sections are embedded in pure paraffin at 56° C. The paraffin is removed by xylol, and the slides are treated successively with absolute and 95 p.c. alcohol and then dropped into a jar of 1 p.c. iodine in 95 p.c. alcohol for 15 seconds. The sections, without washing in water, are counterstained in Harris' hæmatoxylin without acetic acid—washed in 95 p.c. alcohol, followed by water in a beaker, but only long enough to wet their surface thoroughly—dehydrated in alcohol, cleared in xylol, and mounted in neutral balsam. G. M. F.

Thionin Dyes as Biological Stains.—R. HAYNES ("The Staining Properties of Thionin and its Derivatives as compared with their Chemical Formulæ," *Stain Technol.* 1927, 2, 8-16). An investigation has been made of the staining properties of eight dyes of the thionin group. The dyes studied are as follows: tetra-ethyl thionin, asymmetrical di-ethyl thionin, tetra-methyl thionin (methylene blue), tri-methyl thionin (azure B), asymmetrical di-methyl thionin (azure A), symmetrical di-methyl thionin, mono-methyl thionin (azure C), and unsubstituted thionin. The staining properties were tested on sections of paraffin-

embedded material following five different methods of fixation. There was a general correlation between the extent of ethylation or methylation of the dyes and their staining properties. As one passes from tetra-ethyl thionin down the series to thionin itself, there is a progressive decrease in the amount of green showing in the preparations and an increase in the amount of red present, also an increase in the metachromatic effects and in the intensity of nuclear staining. There seems also to be a similar relation between staining qualities on the one hand and the colour and solubility of the dye base on the other.

G. M. F.

Technique for Study of Euglenoid Flagellates.—R. P. HALL and W. N. POWELL ("Notes on Technique for the Study of the Gullet, the Flagellum and its associated Kinetic Elements in Euglenoid Flagellates," *Trans. Amer. Mic. Soc.*, 1926, 45, 256-7). The material is first centrifuged and then fixed either in hot Schaudinn's fluid or in Altmann's fixative for four hours. Material fixed in Schaudinn's fluid is stained as follows: 0.2 p.c. Bordeaux red, 24-48 hours; 4 p.c. iron alum, 24-48 hours; 0.5 p.c. hæmatoxylin, 24-48 hours, destaining in 4 p.c. iron alum, the process to be watched under the microscope. Material fixed by Altmann's method should be stained by Regaud's iron alum hæmatoxylin.

G. M. F.

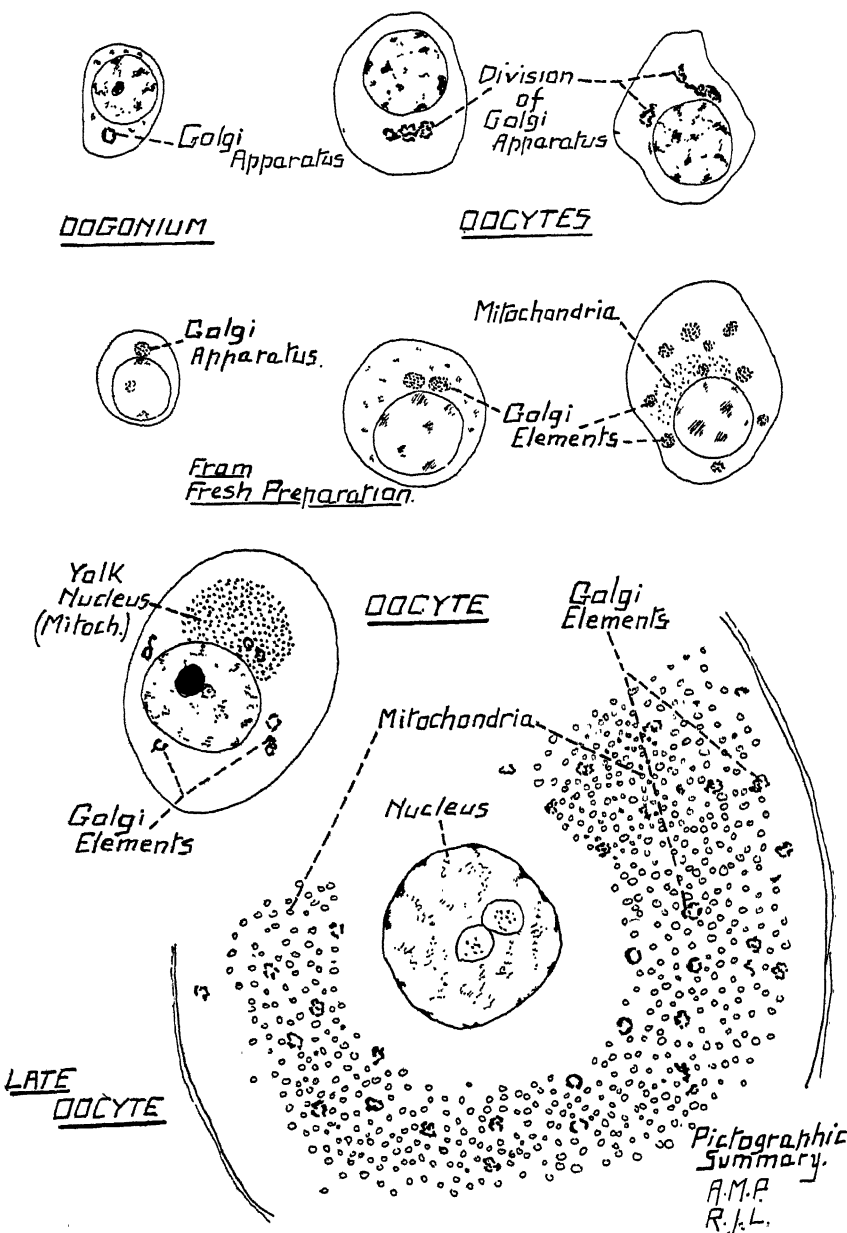
GENERAL CYTOLOGY

Oögenesis of Peripatopsis Capensis.—S. D. KING. ("Note on the Oögenesis of *Peripatopsis capensis*," *Q.J.M.S.*, 1926, 70, 553-558, 7 text-figs.). (1) Nucleolar budding takes place actively in the very young oöcytes, and more slowly later. The nucleolar particles budded off pass towards the nuclear membrane, but extension into the cytoplasm was not observed. (2) The mitochondria are filamentous in the young oöcytes. At first they are grouped together at the side of the nucleus, but later become scattered, in the form of granules, throughout the cytoplasm. (3) Yolk is formed before the mitochondria are scattered. Its origin could not be studied in the material available. R. J. L.

Mechanism of Cell Division.—M. T. BURROWS (*Am. Jour. Anat.*, 1927, 39, 83-134, 21 text-figs.). Cytoplasmic cleavage is the result of a separation of the astral centres and an equalization of cytoplasm of the cells about each of them. These centres cause this equalization of cytoplasm about them and repel each other through the fact that they liberate substances which cause a coagulation of the colloids of the cytoplasm and nucleus, and draw these proteins and other substances to them. The cell suffering from this change first becomes spherical in shape, then it elongates to an ovoid shape as the centres separate, and it cleaves when the centres become sufficiently far apart so that an equalization of the cytoplasm about each astral centre demands a constriction of the cell at the interval between them. Cytoplasmic cleavage is never completed during kinesis. A small strand or several small strands of protoplasm connect the daughter cells at the end of this process. The completion of cytoplasmic cleavage is always due to forces operating in the interkinetic period in body cells or the result of forces acting in the division of the connected daughter cells.

R. J. L.

Golgi Apparatus in Gland Cells.—R. H. BOWEN ("Studies on the Golgi Apparatus in Gland Cells," *Q.J.M.S.*—(1) Glands associated with the Alimentary Tract, 70, 75-112, 6 pls. and 108 text-figs.; (ii) Glands producing lipoidal Secretions—the so-called Skin Glands, 193-216, 3 plates with 69 figs.; (iii)



OÖGENESIS OF LUMBRICUS. J. B Gatenby and V. Nath.

"The Oögenesis of certain invertebrata with special reference to Lumbricus."
Q.J.M.S. (1926), 70, 371-390.

Lachrymal Glands and Glands of the male Reproductive System, 395-418, 4 plates and 88 text-figs.; (iv) A Critique of the Topography, Structure, and Function of the Golgi Apparatus in Glandular Tissue, 419-450, 3 text-figs.). The Golgi apparatus is from the beginning present in all kinds of secretory cells, and during the secretory cycle becomes very greatly hypertrophied, establishing a volume in rough relation to that of the secretory products. The topography and behaviour of the apparatus is different in different kinds of glands, but is roughly divisible into three general types characteristic of cells which produce serous, mucous, and lipoidal secretions. The secretory granules make their first appearance only within the area delimited by the Golgi apparatus. It is concluded that secretory granules are differentiated by the Golgi material, but that no direct transformation of the one into the other occurs. It is suggested that the Golgi material is structurally homologous throughout the range of animal cells, and that the so-called idiosomic substance, sometimes associated with it, is to be looked upon as one phase of a duplex system in which the relative development of lipoidal and idiosomic substances may undergo considerable variation.

R. J. L.

Nuclear Structure in Active and Hibernating Frogs.—J. McA. KATER (*Zeit. f. Zellforsch. u. mikr. Anat.* 1927, 5, 263-277, 19 text-figs.). The chromosome is considered as a linen bag filled with chromatin, while the chromosomal vesicle is looked upon as a linen bag containing, in addition to chromatin, a varying amount of achromatic material taken up from the cytoplasm during the telophase. The linen sheath of the chromosome becomes visible in conjunction with the telophasic vesiculation, and can be followed through interkinesis, thus showing that this unit of nuclear structure maintains its individuality during rest. The prophase chromosomes arise within the vesicle, and are liberated by the dissolution of its walls. The nucleus of hibernating frogs contains much less chromatin than that of summer frogs. The cytoplasm entirely loses its basophilic character. At -2°C . the basophilic material is regained.

R. J. L.

Chromosomes of Gammarus.—R. PALMER ("The Chromosome Complex of *Gammarus Chevreuxi*, Sexton," *Q.J.M.S.*, 1926, 70, 539-551, 1 pl. and 4 text-figs.). The chromosomes are small, ovoid and minutely heteromorphic, and have a diploid number in the male of 26. This number includes in the male an X- and a Y-chromosome, the former being larger and the latter smaller than any of the autosomes. The spermatogonia fall into two distinct classes as regards chromosome size, the large plates being probably merely the later stages of the spermatogonial series. While *Gammarus* does not provide favourable material for the detailed study of synapsis, the chromosomes appear to spin out in the typical way in the early synaptic stages.

R. J. L.

Golgi Apparatus in Spinal Ganglion Cells.—W. P. COVELL ("A Quantitative Study of the Golgi Apparatus in Spinal Ganglion Cells," *Anat. Rec.*, 1927, 35, 149-160, 4 text-figs.). The Golgi apparatus was studied in preparations of the cervical and lumbar ganglia of the rabbit. Material was fixed for 24 hours in Nasonov's modification of Kolatchev's fluid. It was then transferred to 2 per cent. osmic acid and kept at 37.5°C . for eight to nine days. This method gave good impregnations of the Golgi apparatus. The computed surface area of the apparatus was approximately one-half as large as the total cell surface. There was relatively a greater surface area of Golgi apparatus in small cells in relation to cytoplasmic volume than in large cells. In small cells there was relatively less Golgi apparatus surface in relation to nuclear surface than in large cells. There was relatively

more volume to the Golgi apparatus of small cells in relation to cell and cytoplasmic volumes than in large cells. R. J. L.

Intestinal Secretion in Insects.—O. SHINODA. ("Contribution to the knowledge of intestinal secretion in insects"; (ii) "A Comparative Histo-cytology of the mid-intestine in various Orders of Insects," *Zeit. f. Zellforsch. u. mikr. Anat.*, 1927, 5, 278-292, 20 text-figs.). The structure of the mid-intestine of insects is more or less in accordance with their systematic position. In the Lepidoptera nidi are not developed. The mode of secretion is merocrine, and the goblet cell is formed as the resting stage of cellular activity. In the Orthoptera, goblet cells are not seen. The mode of secretion is holocrine when they are strongly stimulated, so that the nidi are considerably developed. In Hymenoptera and Diptera the structure seems to be more primitive. The intestinal diverticula are apparently the most primitive forms of the gastric caeca. R. J. L.

Chromosomes of Cavia.—M. T. HARMAN and F. P. ROOT ("Number and Behaviour of the Chromosomes in *Cavia cobaya* (the Common Guinea-pig)," *Biol. Bull.* 1926, 51, 73-84, 2 pls.). Thirty-eight spermatogonial chromosomes and 19 chromosomes in the primary and secondary spermatocyte cells are recorded. There is an *xy* chromosome which separates in the first maturation division. The material was fixed in cold Flemming's solution to which urea had been added. The temperature was kept at 2° C. The actively dividing cells are not distributed throughout the whole lining of the seminiferous tubules, but are limited to elliptical areas which never exceed two-thirds of the circumference of the tubules and sometimes consist of only a few cells. The greatest diameter of the ellipse is always lengthwise of the tube. G. M. F.

Cellular Inclusions in Sheep Pox.—F. DE GASPERI ("Lesioni e inclusi cellulari nella forma di vaiuolo ovino atipico recentemente dominata nell' Agro Pisano," *Atti d. Soc. Toscana di Sci. Naturali*, 1926, 37, 197-218, 1 plate). Inclusion bodies resembling those originally described by Guarneri in smallpox are recorded in the skin and epithelium of the bronchi. They appear to be nucleolar extrusions. G. M. F.

The Cytology of Fowl-pox.—R. J. LUDFORD and G. M. FINDLAY ("The Ultra-microscopic Viruses.—II. The Cytology of Fowl-pox," *Brit. J. Exp. Path.*, 1926, 7, 256-264, 15 text-figs.). The earliest indication of an infection of an epidermal cell with the virus of fowl-pox is the formation of a small vacuole, to the periphery of which small granules are attached. Mitosis is of common occurrence in cells containing such vacuoles. These "virus" vacuoles increase in numbers and enlarge. Some form of budding is suggested. At the same time the virus vacuoles become enclosed by a lipoidal lining and present a granular appearance internally. Many cells become hypertrophied, and at an early stage of infection there is a complete reversal of polarity in the Golgi apparatus which frequently stands in intimate relationship to the virus bodies. The virus bodies tend to coalesce and there results a single large virus body. G. M. F.

Varicella in Monkeys.—T. M. RIVERS ("Varicella in monkeys. Nuclear Inclusions produced by Varicella Virus in the Testicles of Monkeys," *J. Exp. Med.* 1927, 45, 961-968). Monkeys' testicles inoculated with emulsified tissue of human chicken-pox lesions showed eosin staining nuclear inclusions which are believed to be specifically associated with the virus of varicella. G. M. F.

Giant Cells in the Placenta of the Rabbit.—G. S. SANSOM (*Proc. Roy. Soc.* 1927, 101, 354–368, 9 pls.). Two kinds of giant cells are found in the pregnant uterus of the rabbit. The larger and more conspicuous variety is derived from the foetal trophoblast, cells from which become detached from the blastocyst about the seventh day of gestation and penetrate into the obplacental mucosa. These cells grow rapidly and attain an enormous size, sometimes as much as 0.4 mm. in length. They persist until about the twenty-second day, when fragmentation sets in and they become broken up into comparatively small bodies. Large numbers of these cells are also formed from that portion of the trophoblast of the proximal zone of the bilaminar omphalopleure, which projects free into the uterine cavity after the attachment of the blastocyst to the placental folds on the eighth day and the disappearance of the remainder of the omphalopleure. The cells proliferated off from this “trophoblastic fringe” pass into the uterine cavity of the antimesometrial uterine wall and enter the underlying tissues. The proliferation of this trophoblastic fringe persists until the sixteenth day of gestation. The mesometrial giant cells are of maternal origin, being formed by the proliferation of the endothelial lining of the capillaries in the deep placental region. They appear about the eleventh day of gestation and persist until after the twenty-seventh day. They never attain a great size and are confined to the mesometrial region. The trophoblast of the chorion laeve gives origin to great numbers of multinucleate spheres which become free in the uterine cavity and in the interplacental furrow. These bodies are inactive degenerate structures. G. M. F.

Physical Relation of Cells.—F. E. KREDEL (“The Physical Relation of Cells in Tissue Cultures,” *Bull. Johns Hopkins Hosp.* 1927, 40, 216–227, 1 pl.). No evidence for the existence of the protoplasmic bridges between tissue cultures of chick skin epithelium, liver cells, endothelium, endoderm, smooth muscle or amniotic ectoderm was found. The effect of a mechanical injury at the surface of a cell is transmitted rapidly throughout the cell, but does not appear to affect adjacent cells. As it coagulates an injured cell loses its adhesiveness for other cells. This latter fact indicates the importance of surface tension in the natural adhesiveness of cells. G. M. F.

Ultraviolet Radiation and Arbacia Sperm.—M. A. HINRICHS (“The Effect of Ultraviolet Radiation on the Fertilising Power of Arbacia Sperm,” *Biol. Bull.*, 1926, 50, 473–489). Ultraviolet radiation augments the loss of fertilising power beyond that produced by time and dilution. Dilute sperm suspensions lose their power of fertilization earlier and more rapidly when radiated than do more concentrated suspensions. The rate of loss of fertilizing power is roughly proportional to the dosage of radiation. The motility of sperm is impaired and cleavage is delayed and abnormal. Development is differentially modified. Ultraviolet light produces sperm agglutination. Fertilizing power decreases more rapidly than does motility in both radiated and non-radiated suspensions. Fertilization is incomplete when normal eggs are fertilized by radiated sperm and may in some cases lead only to membrane formation. The loss of fertilizing power is probably due to the loss from the sperm by outward diffusion of some substance necessary for fertilization. Ultraviolet radiation augments the loss of fertilizing power, presumably by altering the surface of the sperm and thereby increasing the permeability to such a substance. G. M. F.

Susceptibility to Radiation.—M. A. HINRICHS (“Modification of Development on the Basis of Differential Susceptibility to Radiation. III. *Arbacia* Germ.

Cells and (a) Ultra-violet Radiation, (b) Visible Radiation following Sensitization," *Biol. Bull.*, 1926, 50, 455-472, 2 pls.). In order that visible radiation following sensitization may be effective the sensitized system, in this case eggs or sperm before fertilization, must be exposed to radiation of sufficient intensity and duration whose wave-length range includes that absorbed by the particular sensitizer used. Ultra-violet radiation is effective without the aid of a sensitizer by virtue of its direct absorption by protoplasm. Regions of high physiological activity are the first to be modified in their development and are the first to recover when the injurious effect is slight. Modification of development by means of radiation produces results essentially similar to those obtained by other means. Development may be modified by subjecting fertilized eggs, soon after insemination, to the action of intense radiation. Modification of development may also be obtained by exposure of either sex component of the zygote to intense radiation prior to fertilization.

G. M. F.

A. VERTEBRATA.

Embryology, Evolution, Heredity, Reproduction and Allied Subjects.

Development of the Human Vascular System.—D. M'INTYRE (*Trans. R. Soc. Ed.*, 1927, 55, Pt. 1, 77-114, 3 pls. and 8 text-figs.). The author gives a description of a new early embryo and an account of blood-vascular development in this (the M'Intyre) and in the Teacher-Bryce No. 2, both being of the presomite stage. He then proceeds to an analysis of Bryce's *Selected List*, with the addition of Meyer's, Triepel's and Ingall's specimens and the two mentioned above. The list is approximately in sequence in respect of differentiation and in arriving at his stated views as to vascular development, M'Intyre has supplemented his own detailed studies of two embryos by correlation so far as possible with the recorded views of others. He considers—(1) that the blood vascular system arises in the extra-embryonic areas by progressive differentiation of mesoderm at multiple points *in situ*; (2) The theory of vascularization of chorion and villi by centrifugal growth of angioblastic tissue does not hold for the human ovum (3) Differentiation to angioblastic tissue occurs slightly later in the villi than in yolk-sac, body-stalk and chorion. (4) The order of connecting up of vascular elements in areas and of areas with one another is: body-stalk and chorion, chorion and villi, body-stalk and yolk-sac; yolk-sac, body-stalk and embryo. (5) In the wall of the yolk-sac blood-cell production is the main concern, while in body-stalk chorion and villi channel formation is equally important. (6) Yolk-sac prolongations across the blastocyst cavity to the chorionic wall have some bearing on vascular development in chorionic membrane, but that the contained endoderm elements are not so concerned. (7) Vessel formation is most rapid in the body-stalk. (8) The arterial and venous systems of the body-stalk do not communicate. (9) Blood-cell forming tissues in body-stalk communicate with vessel channels, but do not project into them. (10) Mesothelium of body-stalk may play some part in vessel formation. (11) Extension of vessel growth does not take place from body-stalk into chorion, but the reverse may perhaps take place in connection with venous channels of body-stalk. (12) The earliest angioblastic tissue in chorionic mesoderm is in the form of nucleated protoplasmic strands; and (13), at this stage the chorionic mesoderm possesses no mesothelium; and, therefore, in this region mesothelium has no rôle in vessel formation. (14) At a very early stage of development the distribution of vascular tissues in the chorion indicates a differentiation of the area around the body-stalk towards placenta.

J. F. C. H.

Implantation of Guinea-pig Embryo.—N. MACLAREN ("Development of *Cavia*: Implantation," *Trans. R. Soc. Ed.*, 1927, 55, 115-124, 3 pls., 5 text-figs.). The author quotes the view of v. Spee that in *Cavia* the implantation cavity is produced outside the uterine lumen by destruction of the subepithelial connective tissue, whereas in mouse, rat and vole the implantation cavity is primarily part of the uterine lumen from which the epithelium has disappeared. MacLaren has made a study of serial sections of a complete series of embryos, and places on his observations an alternative interpretation, bringing the primary phases of implantation in *Cavia* more into harmony with occurrences in mus, etc., than does von Spee's. His view may be summarized as follows:—The embryo lodges in a uterine crypt and the epithelium at the bottom of the crypt becomes thinned. The lips of the crypt gradually enclose the embryo and eventually meet. The epithelium of the crypt becomes obliterated at the bottom, but is still present at the sides, but by the time the crypt's lips meet the epithelium lining the sides have practically disappeared. It appears probable that the lower lip comes in contact with the opposite wall of the uterus, so cutting off the main anti-mesometric pocket. "Implantation then is excentric but not interstitial. The embryo does not penetrate the stratum compactum, but is, as it lies in the crypt, enveloped by folds of epithelium which shut it off from what is really a part of the cavity of the uterus." There is, in *Cavia*, no enveloping sac of trophoblast as figured by Selenka and assumed by Duval; the naked layer of endoderm is bathed by the contents of the destruction space. The text-figures and plates admirably illustrate the author's thesis.

J. F. C. H.

Development of Hypophysis Cerebri in Man.—D. WATERSTON. ("Development of the Hypophysis in Man with a Note upon its Structure in the Human Adult," *Trans. R. Soc. Ed.*, 1927, 55, 125-146, 3 pls., 12 text-figs.). Waterston remarks that too often the development of this structure has been studied from sagittal sections alone, and that such do not suffice to disclose its development and structure. Specimens cut in other planes, specially the transverse are necessary and have been used in his study in which, too, the terms "anterior" and "posterior" applied to the primary elements constituting the fully formed organ are replaced by "oral" and "neural" respectively. The oral element originates in a slit-like pocket transverse to the long axis of the embryo, and the surfaces of this pocket are called "caudal" or "rostral," according as they look towards the tail end or head end. The author's own summary best expresses in brief the result of his work:—(1) The oral lobe appears as a single median depression in the root of the stomodeum. This single depression, however, alters in shape and forms a central stem with two lateral horns, which probably represent the central and lateral chambers described in reptiles. This stage is transitory. (2) The proximal portion of the oral outgrowth is transformed into the stalk, while the distal portion above gives rise to the epithelium of the oral lobe of the hypophysis. Three parts can be recognized in this, a lateral on each side, a central, and a thin anterior lamina, and their origin is as follows:—(a) The lateral margins of the oral pocket form the lateral parts. (b) The central part of the rostral surface forms a cone or plate of tissue intervening between the lateral lobes. (c) From the proximal margin an outgrowth takes place which forms a *pars tuberalis*, ultimately represented by a thin lamina on the rostral surface of (b) uniting the lateral lobes. (3) The caudal wall of the oral lobe for a time invests the adjacent surface of the neural lobe and forms a *pars intermedia*, separated by the intraglandular cleft from the anterior lobe proper. (4) The intraglandular cleft disappears at an early stage on each side in the "lateral parts," by fusion

of the opposite surfaces, and later on disappears almost completely centrally. (5) There is in the adult human hypophysis no definite *pars intermedia* and no distinct intraglandular cleft. The oral and neural lobes are separated by a thin connective tissue, in whose central part are numerous follicles containing colloid or granular material. (6) The neural lobe represents, not only a median unpaired outgrowth, but also contains the rudiments which represent the bilateral "saccus vasculosus" of elasmobranch fishes.

J. F. C. H.

Developmental Capons and Poulardes.—A. W. GREENWOOD and F. A. E. CREW ("Studies on the Relation of Gonadic Structure to Plumage Characterization in the Domestic Fowl. II. The Developmental Capon and Poularde," *Proc. Roy. Soc.*, 1927, B, 101, 449). Eleven untreated birds are described which throughout their life retained all the features of individuals completely without gonads, except that the combs, though small, were bright and healthy-looking. This apparently gonadectomised condition was found to be correlated in each case with complete absence or reduction in size of the gonads. Where gonad tissue was present spermatogenesis was imperfect. Of those eleven cases gonad tissue was completely absent in one. One testis only was present in two cases, while a small ovary only was also found in two cases. Two testes of small size, however, were found in each of six of the birds, in three cases being associated with no other obvious abnormality, while developmental defects were present in the other three. The causes of this gonad infection could not be definitely arrived at from the material available.

A. S. P.

Vitality of Spermatozoa.—J. HAMMOND and S. A. ASDELL ("The Vitality of the Spermatozoa in the Male and Female Reproductive Tracts," *Brit. Journ. Exp. Biol.*, 1926, 4, 155). The longevity, as assessed by the retention of their fertilizing power, of the spermatozoa in the male genitalia of the rabbit may be ascertained by ligation of the tail of epididymis. After this operation fertility is found to be retained for periods up to 38 days. In the female genitalia, however, they lose their fertilizing power within 30 hours, as may be found by controlling the time of ovulation by mating with a vasectomized buck. Between 24 and 30 hours the size of litter tends to be small, suggesting a gradual loss of vitality.

A. S. P.

Compensatory Hypertrophy of the Rat Ovary.—F. A. E. CREW ("On the Effects of Unilateral Ovariectomy and Salpingectomy in the Rat," *Biologia Generalia*, 1927, 3, 207). After unilateral ovariectomy the size of litter was found to be fairly normal, and the addition of unilateral salpingectomy on the same side as the ovariectomy was not found to affect this normal litter size. Unilateral salpingectomy alone, however, reduced the litter size by about 50 per cent., which seems to indicate that the two ovaries contribute fairly equally to the number of ova produced. Unilateral ovariectomy, and salpingectomy on the other side, resulted in complete sterility. It is justifiably concluded that these results confirm previous workers in finding that after unilateral ovariectomy the remaining ovary will undergo hypertrophy and take on the work of two ovaries, and that the results suggest most strongly that neither external nor internal migration of ova takes place in the rat.

A. S. P.

Sex Characters in "Lebistes reticulatus."—L. J. BLACHER ("The Dependence of Secondary Sex Characters upon Testicular Hormones in *Lebistes reticulatus*," *Biol. Bull.*, 1926, 50, 374-381, 13 text-figs.). Atrophy of the testis in male *Lebistes* is followed by the disappearance of the male sex colours. The

female colouration is the characteristic colouration of the asexual forms. The male fish is heterozygos (xy) as to sex chromosome composition and the female is homozygos (xx). A hermaphrodite with both ovary and testis is described..

G. M. F.

Experimental Hermaphroditism in Hens.—M. M. ZAWADOWSKY ("Bisexual Nature of the Hen and Experimental Hermaphroditism in Hens," *Biologia Generalis*, 1927, 3, 129). After removal of the left ovary of the hen, the right sexual gland develops and assumes a histological structure similar to that of the testis. Seminiferous tubules are present, of which certain show the first stages of spermatogenesis, but tubules showing mature sperms are rare. The male characters dependent upon the testis developed in the ovariectomised hen in close connection with the development of the right gonad. The feathering of the ovariectomised hen shows a mixture of male and female characters, which seems to indicate that both sex hormones (*feminisin*, *maskulinisin*) are produced by the right gonad. The normal (left) ovary of the hen implanted from its natural site into any other part of the body produces tissue of a testis type similar to that produced by the right gonad. The same transformation is sometimes found when regeneration of the left gonad takes place after incomplete removal. The morphogenetic action of the testis-like tissue sometimes produced by the left gonad is similar to that of the right gonad of the ovariectomised hen. A. S. P.

The Hormone Control of the Mammary Glands.—E. HOMANN ("Beitrag zur hormonalen Beeinflussung der weiblichen Mamma," *Naturforsch. Gesell.*, 1926, 26, 289). The mammary glands of non-pregnant rats did not show any degree of development following blood transfusion or the transplantation of various non-reproductive organs from pregnant animals. Similar negative results were obtained by the injection of extracts of various non-reproductive organs from pregnant to non-pregnant animals. The transplantation of ovaries, however, from pregnant to non-pregnant rats, mice, guinea-pigs and rabbits produced a reaction on the part of the mammary glands of the non-pregnant animals. It was also found that excision and damaging of the ovaries produced little, if any, atrophy of the mammary glands, whereas coincident ovariectomy and hysterectomy did result in atrophy. From these results the author concludes that the uterus, as well as the ovaries, is a necessary link in the chain required for the maintenance of the mammary apparatus. A. S. P.

Sperm Density and Fertility.—A. WALTON ("The Relation between 'Density' of Sperm-Suspension and Fertility as Determined by Artificial Insemination of Rabbits," *Proc. Roy. Soc.*, 1927, B, 101, 303). By means of artificial insemination of rabbits it is shown that fertility is very definitely influenced by the number or the density of the spermatozoa introduced into the female genitalia. A density represented by less than 10^4 spermatozoa per 3 c.c. always results in sterility. Between 10^4 per 3 c.c. and 10^6 per 1 c.c. a certain degree of fertility is found, but full fertility only occurs when the number of spermatozoa exceeds 10^6 per c.c. Three factors are probably concerned in producing these results. In the first place the probability that any particular spermatozoon will reach a fertilizable ovum is small; secondly, spermatozoa are variable, and are not all capable of effecting fertilization; and, thirdly, toxicity may act differentially according to the density of the sperm suspension. A. S. P.

The Rosettes of the Foetal Pig Placenta.—C. E. ABROMAVICH ("The Morphology and Distribution of the Rosettes on the Foetal Placenta of the Pig,"

Anat. Rec., 1926, 33, 69). Rosettes or "white spots" on the placenta of the sow were reported by John Hunter as early as 1781. Two essentially different types of rosette have been distinguished. The first type is cup-shaped, and the inner wall of the cup is usually broken up into five or six corrugations which run towards the centre. The lip of the cup, situated on the maternal side of the foetal placenta, is thickened so as to form a ridge protruding above the surface. The cup-shaped rosettes are always nearly circular in outline, but in some cases the fusion of two cups may result in the formation of an irregular structure. The second type of rosette possesses no regular geometrical design, and varies much in shape. No ridges are given off from the periphery. Sometimes the irregular structure may assume a plaque shape, with a wide shallow cavity, which, on occasion, may assume the form of a deep pit. The characteristic differences between this type and the first type of rosette are the irregularity of outline, the greater size (about three times the area), and the presence of papilla-like structures. Each type of rosette has a type of vascular system peculiar to itself. A. S. P.

Absorption of Dyes by the Chick Embryo.—E. B. HANAN ("Absorption of Vital Dyes by the Foetal Membranes of the Chick. 1. Vital Staining of the Chick Embryo by Injections of Trypan Blue into the Air Chamber," *Am. Jour. Anat.*, 1927, 38, 423–450, 3 text-figs.). From the fourth day of incubation, the chick embryo may be vitally stained by injections of trypan blue. The chorionic ectoderm of the chick allantois is permeable to trypan blue. The dye reaches the embryo through the blood and lymphatic vessels of the chorioallantois, phagocytosis apparently playing an important part in the passage of the dye into these vessels. Trypan blue in the foetal circulation is excreted by the kidneys and appears in the allantoic fluid, but not in the amniotic fluid. After the twelfth or thirteenth day of incubation, trypan blue stored in the albumen sac may enter the amniotic cavity accompanied by part of the albumen. The dye appears in both the gastro-intestinal and the respiratory tracts, while the albumen appears only in the gastro-intestinal tract. The remainder of the albumen, instead of entering the amniotic cavity, passes into the yolk through the yolk-sac umbilicus. R. J. L.

Germ Cells of "Cottus bairdii" (Girard).—H. W. HANN ("The History of the Germ Cells of *Cottus bairdii* (Girard)," *J. Morph. and Physiol.*, 1927, 43, 427–497, 8 pls.). The primordial germ cells are derived from entodermal giant cells, which are found first before the gut is formed and later along the ventral and lateral margins of the gut. Some of these cells pass through the lateral mesoderm to a position dorsal to the gut, where they are distinctly recognizable as germ cells. They are then shifted to the gonad region. Some of the oocytes formed during the first season mature for the first spawning which takes place at the age of two years. The remainder form a reserve supply, which is increased each year by oocytes formed from dormant oogonia. Spermatogonia lying dormant within the cysts during maturation give rise to the sperm of the next season. Definitive sex cells in both sexes have their origin only in primordial germ cells. No transition from somatic to germ cells was found at any stage. G. M. F.

Histology.

Ossicles of the Badger.—H. C. WILKIE (*Proc. Zool. Soc.*, 1926, 815–823, 5 text-figs.). This gives a detailed anatomical account of these structures, amplyifying the brief description of the ossicles given by Doran, and adding details of

the ligaments and musculature not previously recorded. In the morphological characters he traces features associated with the carnivora and others more generally considered as belonging to the insectivora. The malleus presents a striking conical prominence which does not form the point of attachment for ligament or tendon, and whose function is obscure. The incus has remarkable resemblance to that of the bear, and the processus longus shows, on its anterior face, the channelling recorded in some of the insectivora. The description of the muscular and ligamentous structures cannot be summarized, but it may be noted that the tensor tympani muscle is large and highly developed. · J. F. C. H.

Photogenic Organ of the Knight-fish.—Yô K. OKADA. ("On the Photogenic Organ of the Knight-fish (*Monocentris japonicus*, (Houttuyn")), *Biol. Bull.* 1926, 50, 365-373, 7 text-figs.). The photogenic organs of the knight-fish are situated on each side of the median thickening of the lower jaw; they are of a glandular nature and when pressed under conditions of darkness a luminous fluid can be expressed. The epithelium of the secretory tubules is completely destroyed during the process of secretion, the new epithelium being replaced by the constant proliferation of cells. Observations on the living fish show that normally no luminous material is excreted externally; the luminescence being extracellular but intraglandular. G. M. F.

The Relationship between the Lining Cells of Serous Cavities and Cells of the Serous Exudate in Inflammatory Tissue and in Tissue Culture.—A. MAXIMOW ("Über das Mesothel (Deckzellen der serösen Häute) und die Zellen der serösen Exsudate. Untersuchungen an entzündetem Gewebe und an Gewebskulturen," *Archiv. f. exp. Zellforsch.*, 1927, 4, 1-42, 3 text-figs. and 5 pls.). A discussion of the origin of the inflammatory cells of serous exudates and the changes which they undergo in tissue culture. G. M. F.

Tubercle Bacilli and Tissue Cultures.—A. D. TIMOFEJEWSKY and S. V. BENEWOLENSKAJA ("Tuberculous Inoculation in the Cultures of Leukocytes of the Human Blood," *Archiv. f. exp. Zellforsch.*, 1927, 4, 64-78, 4 text-figs.). There has long been discussion as to the origin of the epithelioid cells of tuberculous nodules. Baumgarten's view was that these cells were derived from local tissue cells without any participation of non-granular blood leucocytes. Metchnikoff and others brought forward evidence in support of the hæmatogenous origin of epithelioid cells from non-granular leucocytes. Tissue cultures of non-granular leucocytes inoculated with tubercle bacilli produce definite tubercles composed of epithelioid cells which rapidly undergo necrosis. G. M. F.

Blood Vessels of Bone Marrow.—H. E. JORDAN and J. P. BAKER, JUN. ("The Character of the Wall of the Smaller Blood Vessels in the Bone Marrow of the Frog, with special reference to the question of erythrocyte origin," *Anat. Rec.*, 1927, 35, 161-184, 4 pls., 20 figs.). In hypoplastic femoral marrow of the frog the venous sinusoids are directly continuous with the intercellular spaces of the fatty reticular stroma. This view is confirmed by injecting the white marrow with indian-ink suspensions. Experimental hyperplastic marrow, following splenectomy, shows that erythrocytogenesis is a matter of the differentiation of lymphocytes originating from reticulum cells. These red-cell ancestors mature both within endothelium-lined and also within reticulum-lined tissue spaces. The reticular stroma increases at the expense of the fat-cells. Reticular cells separate from the stroma, assume spheroidal shapes, and as lymphocytes are either swept into venous sinuses to differentiate into erythrocytes or aggregate into clusters and

differentiate *in situ*. The tissue space containing such maturing erythrocytes is in connection with a venous sinus, and its encircling reticulum-cell membrane is continuous with the endothelium of the sinus. The vascular and erythropoietic conditions are essentially identical in spleen and marrow of the frog.

R. J. L.

Endocrines of Chickens.—J. F. NONIDÉZ and H. D. GOODALE ("Histological Studies on the Endocrines of Chickens deprived of Ultra-violet Light. I. Parathyroids," *Am. Jour. Anat.* 1927, **38**, 319–348, 13 figs.). The combined effect of lack of direct sunlight and a ration poor in antirachitic vitamin results in enlargement of the parathyroids of growing chicks. This enlargement is due to increase in the size and also in the numbers of the cells. It is followed by a phase of regression when the epithelial cords appear shrunken. The parathyroids of chickens deprived of ultra-violet light for five weeks and subsequently exposed to direct sunlight are much smaller than the corresponding organs in younger birds not receiving exposure. Such decrease in volume of the glands is due to decrease in cell size resulting in considerable crowding of the epithelial cells.

R. J. L.

B. INVERTEBRATA.

Mollusca.

Genetic Experiments with Pond Snails *Lymnaea* and *Physa*.—E. D. CRABB (*Amer. Nat.* 1927, **61**, 54). Breeding experiments on a small scale with *Lymnaea stagnalis* with notched shells or bifurcated tentacles, with *Physa gyrina* laying coiled egg masses, having a black penis or a bifurcated tentacle, failed to give any evidence that these characters are heritable. The author doubts the possibility of biparental inheritance in *Lymnaea*.

E. W. B.

Arthropoda.

Insecta.

Copulatory Structures in Lepidoptera.—N. J. KUSNEZOV ("The Morphology of the Copulatory Structures in some cases of Gyandromorphism in Lepidoptera," *Biol. Bull.* 1926, **51**, 245–256, 10 text-figs.). The dependencies and correlations between the copulatory organs and external sexual characters in five gyandrous specimens are described, viz. *Argynnis paphia* L., *Gonopteryx rhamni* L., *Bupalus piniarius* L., *Malacosoma neustria* L., and *Lycæna argus* L.

G. M. F.

New Species of *Phlebotomus*.—C. PINTO ("Phlebotomus *neivai* e *Phl. fischeri* N. Sp. Sobre o aparelho espicular dos phlebotomos e sue valor específico," *Sciencie Med.* 1926, **4**, 370–375, 6 text-figs.). Two new species from the province of S. Paulo, Brazil, with figures of the male genitalia and maxillary palps.

G. M. F.

American Species of *Mydaiidæ*.—C. W. JOHNSON ("A Revision of some of the North American Species of *Mydaiidæ*," *Proc. Boston Soc. Nat. Hist.*, 1927, **38**, 131–145, 1 pl.). The species of this family, though large and conspicuous, are, with few exceptions, extremely rare. The great variation in the same species, often representing sexual dimorphism, has added considerably to the difficulties in determining their true relationships. The genera of this family seem poorly defined.

The author has, however, endeavoured to make a table based largely on characters peculiar to both sexes, supplemented by the secondary characters mentioned by Gerstaecker and Williston. A table is also included for the identification of the twenty-one species with which the author deals; six of these species being new to science. The position and characters of each species are separately discussed, references to the original descriptive papers being included. M. E. M.

Collembola from Spitsbergen.—G. H. CARPENTER ("Further Records of *Collembola* from Spitsbergen," *Proc. Roy. Irish Acad.*, 1927, 37, 1 text-fig.). The records of springtails in this paper may be regarded as supplemental to those included in the list of *Collembola* from Spitsbergen and Bear Island by Carpenter and Phillips (1922), No. 18, of the "Results" of the Oxford University Expedition to the archipelago in 1921. There has now been added the information derived from the work of Merton College Expedition to Spitsbergen in 1923, and of the Oxford University Arctic Expedition in 1924, in the course of which further excellent faunistic and ecological research was carried on. The collection and observation of the springtails, which form the subject of the present paper, were again undertaken by Mr. C. S. Elton. The investigations of the years 1923 and 1924 have yielded sixteen species, of which eight had been taken on Spitsbergen by the first Oxford Expedition (1921). Of the remaining eight species, six were already well-known members of the Spitsbergen fauna. Another, *Sminthurinus niger*, Lubb., previously recorded from Bear Island, is now certified as an inhabitant of Spitsbergen proper. The remaining species, *Isotoma olivaceæ*, Tullb., of which a single specimen was found above the shore of Green Harbour (Icefjord, West Island) is an interesting addition to the recorded fauna of Spitsbergen. A systematic list gives notes on the general distribution only in the case of those species not recorded in Carpenter and Phillips' Spitsbergen List of 1922. M. E. M.

The Morphology of Gyrinidæ.—M. H. HATCH ("The Morphology of *Gyrinidæ*," *Michigan Acad. of Sci. Arts, and Letters*, 1926, 7, 5 pls.). The present paper describes the chitinous skeleton of the coleopterous family *Gyrinidæ* in terms of the accepted homologies of insect anatomy. MacGillivray's "External Insect Anatomy" (1923) has served as the base of the work, though emendations by Crampton and others are accepted, and a limited number of new terms for minor or special gyrinid structures have been introduced. The details of the anatomy are dealt with under the following separate headings:—Head and appendages; Thorax and appendages; Abdomen and appendages; and the paper concludes with a supplementary note on Georg Och's work on Gyrinid Phylogeny. M. E. M.

Australian Robber-Flies.—G. H. HARDY ("A Reclassification of Australian Robber-Flies of the *Cerdistus-Neotamus* Complex (*Diptera-Asilidæ*)," *Proc. of the Linn. Soc. of N.S.W.*, 1926, 51, 643-657, 7 text-figs.). For Australian Asilids, as also those of elsewhere, generic names are being used that were founded upon European species and without true regard to relationships. White pointed out these shortcomings very effectively when he made the first effort to put the more obscure Asilidæ on a better basis. The author is indebted to Professor M. Bezzi, who has kindly supplied him with a number of Asilids representing the typical forms of their genera, thus enabling him to develop White's suggestions. The distinct differences between the genera are indicated, and identification keys to both genera and species are given. Notes are included on some types in the British Museum. A full description of each species is provided, and in most instances the known distribution is recorded. M. E. M.

Tasmanian Spiders.—V. V. HICKMAN ("Studies in Tasmanian Spiders," *Papers and Proc. Roy. Soc. of Tasmania*, 1927, 52–86, 6 pls. and 20 text-figs.). The paper deals with material collected in both the north and south of Tasmania. Six new species are described. Among the *Aviculariidae* two very interesting genera are represented, namely *Migas* and *Hexathele*, both of which are typical New Zealand genera. Full descriptions of the following families, sub-families, genera, and species are made. Fam. *Aviculariidae*, Sub-fam. *Miginæ*, Gen. *Migas* (L. Koch), *Migas nitens*, sp. nov. Sub-fam. *Ctenizinae*, Gen. *Arbanitis* (L. Koch), *Arbanitis scaurus*, sp. nov. Sub-fam. *Diplurinae*, Gen. *Atrax* (O. P. Cambr.), *Atrax venenatus*, sp. nov., *Atrax pulvinator*, sp. nov. Gen. *Hexathele* (Ausserer), *Hexathele montanus*, sp. nov. Fam. *Theridiidae*, Gen. *Ariamnes* (Thor.), *Ariamnes patersoniensis*, sp. nov. Fam. *Clubionidae*, Sub-fam. *Micariinae*, Gen. *Myandra* (Simon), *Myandra bicincta*, Simon. M. E. M.

Australian Lepidoptera.—A. J. TURNER ("A Revision of Australian Lepidoptera—*Drepanidae*, *Limacodidae*, *Zygænidæ*," *Proc. Linn. Soc. of N.S.W.*, 1926, 51, 411–445). The present instalment, after a few supplementary notes on families previously dealt with, contains a revision of three unrelated families, one of which is moderately represented in the Australian fauna, and the other two only to a small extent. Tables for the identification of the genera and species are provided, and the known distribution of species is recorded in each case.

M. E. M.

Sumatran Earwigs.—MORGAN HEBARD ("Studies in Sumatran Dermaptera," *Proc. Acad. of Nat. Sci. of Philadelphia*, 1927, 79, 23–48, 1 pl.). The paper deals with a collection made by E. Jacobson at Fort de Koch, which was sent to the author by Dr. Roland Thaxter. Difficulty in making accurate determinations without detailed study was encountered, but the series, combined with unreported Sumatran material received in exchange from the Burr Collection at the British Museum by the author, proved sufficient to warrant such work. The results obtained are reported; over nine hundred and eighty specimens having been studied representing nineteen genera and thirty-two species, of which three genera and four species are new. Though many species which undoubtedly occur in Sumatra are not included, large series of certain species are of particular interest in showing the wide individual differentiation which often is found in the *Dermaptera*. Macropterous and brachypterous, as well as macrolabial, brachylabial, and cyclolabial forms occur, and in some of the species such individual change in the forceps is accompanied by difference in their armament and even in the shape of the pygidium. Most of the material is in the author's collection at the Academy of Natural Science of Philadelphia. M. E. M.

Harvest-Spiders of Ireland.—R. D. PACK-BERESFORD ("A List of the Harvest-Spiders of Ireland," *Proc. Roy. Irish Acad.*, 1926, 37, 125–140). The harvest-spiders or harvestmen (*Opiliones* or *Phalangidae*) are a small group closely allied to true spiders, and consequently often mistaken for such by amateur collectors and the general public. They differ materially in structure, and also by the fact that whereas the true spider will touch nothing it has not itself captured alive, the harvestmen are regular scavengers. The author gives a list of species with the number of county divisions in which they have been found, and also a list of the forty county divisions into which Ireland is divided by Dr. R. Lloyd Praeger in his "Irish Topographical Botany" (1901), showing the number of species.

that have been found so far in each division. The genera and species dealt with are :—

- Genus, *Nemastoma*.
Nemastoma lugubre, O. F. Müller.
Nemastoma chrysomelas, Herm.
- Genus, *Liobumum*.
Liobumum rotundum.
Liobumum blackwelli, Meade.
- Genus, *Mitopus*.
Mitopus morio, Fabr.
Mitopus morio, var. *alpinus*, Herbst.
- Genus, *Oligolophus*.
Oligolophus agrestis, Meade.
Oligolophus tridens, C. L. Koch.
- Genus, *Lacinus*.
Lacinus ephippiatus, L. C. Koch.
- Genus, *Phalangium*.
Phalangium opilio, L.
- Genus, *Opilio*.
Opilio parietinum, de Geer.
- Genus, *Platybunus*.
Platybunus triangularis, Herbst.
- Genus, *Megabunus*.
Megabunus diadema, Fabr.

M. E. M.

Chromosome and Genetic Behaviour in *Sciara*.—C. H. METZ, M. S. MOSES, E. N. HOPPE ("Chromosome Behavior and Genetic Behaviour in *Sciara* (Diptera), I. Chromosome Behaviour in the Spermatocyte Divisions," *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 1926, 42, 4). In a recent preliminary account (Metz 1925) attention was called to the peculiar relationship between the chromosomes of the two sexes in *Sciara*, and to certain peculiarities in the spermatocyte divisions in this genus. The former topic was treated in detail in a second paper (Metz 1926), and the latter topic is dealt with similarly in the present account. No attempt is made to give a complete description of spermatogenesis. The aim is simply to trace the history of the chromosomes through the maturation divisions. An account is given of chromosome behaviour in the spermatocyte divisions of four species of *Sciara*. The primary features considered are the following :—1. Males possess two more chromosomes than the females, these two being sex-limited in their transmission and having no mates or homologues among the other chromosomes. 2. In the diploid groups of females the chromosomes associate intermediately in pairs in fashion characteristic of the *Diptera*. 3. In the males no such paired association is seen, instead the chromosomes appear to be scattered at random in the nucleus, with the exception of the two sex-limited chromosomes which show a tendency towards loose association. 4. Apparently no synapsis occurs in spermatogenesis. The chromosomes are univalent and diploid in number in the prophase of the first (reductional) division. 5. This division is monocentric, with the chromosomes all attached by spindle fibres to one pole, but nevertheless, a segregation of chromosomes is affected. The division exhibits a series of peculiarities—these are summarized on page 256, under "Interpretation of Data." 6. From the behaviour of the chromosomes it is inferred that two forces are acting on (at least) those which go away from the visible spindle pole. One force, represented by the spindle fibre, exerts a pulling

or retarding action in the direction of the pole, while the other acts in exactly the opposite direction and carries the chromosomes bodily away from the pole. 7. Segregation is unequal. Four of the ten chromosomes go away from the pole. A similar set of four, plus the two sex-limited chromosomes go toward the pole. 8. The former group is cast off in a bud at the ensuing asymmetrical cell division, while the latter group of six is retained in the second spermatocyte, which is practically as large as the first. 9. The second division figure is bipolar, with a flat equatorial plate. Five of the chromosomes, including both the sex-limited ones, lie in this plate. They all divide and send daughter halves to both poles. The sixth chromosome goes precociously to one pole in prophase, although attached by spindle fibres to both poles. It splits, but both halves remain at this pole. The group at this pole thus consists of five single chromosomes and one double one. This group is retained in the cell that forms a spermatid. The other group (of five) is cast off in a bud during the division which, like that of the first spermatocyte, is asymmetrical. 10. Thus only one spermatid is derived from each primary spermatocyte, and all spermatids appear to have the same chromosome complement. Pending the completion of critical genetic experiments and studies on oogenesis the authors make no attempt to offer final explanations of these phenomena, but certain hypothetical considerations are included which cover most of the observed peculiarities.

M. E. M.

Biology of the Scorpion.—W. SCHÜLTZE ("Biology of the Large Philippine Forest Scorpion," *Philippine J. Sci.*, 1927, 32, 375-388, 4 pls.). A pregnant female scorpion, *Palannæus longimus*, Herbst, or *P. oatesii*, Pocock, from Malangas, Mindanao, was placed in a museum-jar measuring 8 in. by 9 in. by 9 in., on June 15th, 1925. The bottom of the jar was covered to the extent of an inch with slightly moist fine river sand, on which was placed several pieces of curved bark. The scorpion showed nocturnal activities, and seemed to dislike bright daylight. It exhibited a desire for water while in captivity, and drank comparatively large amounts of water each day. The process of drinking was mostly accomplished by the mandibles taking up the water from the grooves in the bark. As food the scorpion was given *Acrididae*, *Gryllidae*, *Blattidae* and earth-worms, but it would only consume the *Gryllidae* and all species of *Blattidae*. The scorpion caught its prey and held it off the ground to prevent the struggling cockroach from getting a foot-hold. During the long period of observation the scorpion was never seen to use its poisonous "stinger" in procuring or subduing the insects serving as food. The author believes that the poisonous "stinger" is only used as a defensive weapon against its enemies, and that it is not well adapted to penetrate chitin of ordinary thickness. On July 25th eleven young were born. When first observed, eight were located on the back of the mother, and three others were clinging to the forelegs and underside of the parent's body. The birth of other young scorpions occurred later and was witnessed by the author. The young scorpions are very sluggish, plump, very pale, glossy, and of a creamy white colour. The female gave birth in all to thirty-four young, and for the first few days after birth they shrank in size and became darker. Eight days after birth they were seen to be going through a series of lively contortions, and it was noticed they were moulting for the first time. Between the dates August 3rd, 1925, and November 1st, 1926, the young scorpions moulted seven times. The parent exhibited great maternal care, even teaching her young how to capture and consume their prey. One of the young scorpions reached the adult state in three hundred and forty-five days, eight specimens took from four hundred to four hundred and sixty-four days to do so, while even by that time four specimens had not undergone the seventh

moult. The mother scorpion died apparently from natural causes on May 24th, 1926, and up to the present time (February, 1927), the young adults have manifested no signs of courtship or other actions which could be interpreted as indicating an approach to a mating period.

M. E. M.

Spermatogenesis in *Drosophila*.—C. W. METZ ("Observations on Spermatogenesis in *Drosophila*," *Zeitsch. f. Zellforsch. u. mikr. Anat.*, 1926, 4, 1-28, 5 pls. and 7 text-figs.). The present paper has been prepared more or less piecemeal over a period of many years, much of the manuscript and many of the figures having been completed several years ago for use in connection with the larger study of gametogenesis in the *Diptera*. Since completion of the latter study is delayed by other work the account is presented as it stands. The author describes the technique employed. The spermatogenesis in *Drosophila virilis* is dealt with in considerable detail, and comparative data with that on *Drosophila melanogaster*, *D. willistoni*, *D. funebris*, and *D. obscura* is provided. The author concludes his paper by a full summary under fifteen separate headings.

M. E. M.

Miniature-Alpha.—A Mutating Character in *Drosophila*.—M. DEMEREC ("Miniature-Alpha—A Second Frequently Mutating Character in *Drosophila virilis*," *Nat. Acad. Sci.* 1926, 12, 687-690). The first frequently mutating character observed in *Drosophila virilis* was the body character "reddish," which was found to mutate frequently to wild type. The time of occurrence of the mutations was found to be limited to the maturation divisions of heterozygous females, no mutation in somatic cells was ever detected. Also no mutations were observed in male or homozygous "reddish" females. Miniature-alpha wing character is the second frequently mutating character found in *Drosophila virilis*. The behaviour of miniature-alpha differs in several respects from the behaviour of "reddish," but like "reddish," miniature-alpha mutates to wild type. Wild-type flies were obtained from miniature-alpha as follows: (1) In F_1 females from crosses between miniature-1 females, and miniature-alpha males; (2) in F_2 progenies from miniature females of the same cross; (3) in the progenies of homozygous miniature-females. In its general behaviour miniature-alpha can be compared with well-known, frequently mutating genes in plants, which produce chlorophyll and anthocyan variegations. On the other hand, it differs strikingly from the gene for "reddish" because it mutates in all stages of development. The mutating period of "reddish" is strictly limited to the maturation division of heterozygous females.

M. E. M.

Exploration of the Persian Gulf.—J. D. ALFKEN (Contribution No. 3. Apidae (Hym.). *Entom. Mitteilungen*, 1927, 16, 148). The catch of bees is in many ways worthy of notice. It includes, for one thing, two species, *Anthophora leucomela*, D.T. (*melaleuca*, Walk.), and *Dasygaster albipila*, M. Spin., which have never been seen or handled since the time they were first described. The author gives a more detailed description of these two than was given by the describers of the species, and also information from the collection as to the distribution of certain species. F. D. Morice has already observed that *Anthophora byssina*, Klg., *Megachile schnabli*, Rad., and *Celiogys hamorrhoea*, Först., occur in Mesopotamia. The occurrence of *Andrena creniventris*, F. Mor., which is widely distributed in the South of Europe is noteworthy. This little collection shows that the region round the Persian Gulf will yield much that is new and supply important light on the distribution of the species.

Species found :—

- Andrena rutila*, M. Spin., var. *albifacies*, var. nov. (f.).
A. æneiventris, F. Mor. (f.).
Dasypoda albipila, M. Spin. (f.).
Nomia rufiventris, M. Spin. (m.).
N. rufiventris, M. Spin., var. *albicincta* (f.).
N. magretti, Grib. (? *latipes*, F. Mor.) (m.).
Anthophora (*Alfkenella*) *quadrifasciata*, Vill., var. *Basra* (m.).
A. (A.) leucomela, D.T. (*melaleuca*, Walk.) (m.).
A. byssina, Klgl., Basra (m.).
Xylocopa fenestrata, F. Basra (m. and f.).
X. (Mesotrichia) æstuans L. (*leucothorax*, Deg.) (m. and f.).
Apis florea, F. (f.).
Osmia latreillei, M. Spin. (f.).
Megachile schnabli, Rad. (m.).
Coelioxys hæmorrhœa, Först. (m.).

Zoogeographical summary :—Species of the palæarctic region, of which some, as *Osmia latreillei*, *Nomia rufiventris*, and *Andrena æneiventris*, are widely distributed in the Mediterranean region, others, as *Xylocopa æstuans*, *Dasypoda albipila* and *Anthophora byssina*, have doubtless immigrated from Egypt, and one, *Megachile schnabli*, from Central Asia. *Xylocopa fenestrata*, F., information as to the distribution of which is very indefinite, is a species which has probably immigrated from the East (? India). M. E. M.

Nemathelminthes.

Nematoda.

Nematodes in Thermal Waters.—R. J. C. HOEPLI ("Studies of Free-Living Nematodes from the Thermal Waters of Yellowstone Park," *Trans. Amer. Micr. Soc.*, 1926, 45, 234–255, 3 pls.). Free-living nematodes were found in water even at a temperature of 40° C. Eleven different species were found of which four were new. There were no morphological peculiarities due to the high mineral content of the water. Descriptions of the new species are given.

G. M. F.

Platyhelminthes.

Trematoda.

Intestinal Parasites of Bat.—G. D. BHALERO ("The Intestinal Parasites of the Bat (*Nyctinomus plicatus*), with a List of the Trematodes previously recorded from Burma," *J. Burma Res. Soc.*, 1926, 15, 181–195, 2 pls.). Heavy trematode infections were found in five of the six bats examined, the number of worms in each bat varying from a dozen to about three hundred. These comprised four new species and four new varieties. No cestodes or Acanthocephala were found. Full descriptions of the new forms are given, together with a list of trematodes from Burma, arranged—(a) systematically, (b) under hosts. J. L.

Proalaria Huronensis, sp. nov.—G. R. LA RUE ("Studies on the Trematode Family Strigeidæ (Holostomidæ). V. *Proalaria Huronensis*, sp. nov.," *Trans. Am. Micr. Soc.*, 1927, 46, 26–35 2 pls.). The new species described and figured in this paper was found in 100 p.c. of the herring gulls examined from Lake Huron district. So far the author has been unable to trace the source of the infection but further experiments to this end are being made. J. L.

Seasonal Infestation with Larval Trematodes.—H. M. MILLER and F. E. NORTHUP ("The Seasonal Infestation of *Nassa obsoleta* (Say) with Larval Trematodes," *Biol. Bull.* 1926, **50**, 490–508, 2 pls.). The common mud snail *Nassa obsoleta* was found to be heavily parasitized with larval trematodes. There seems to be a semi-annual rise and fall in the infestation. As none of the adults of these larvæ are known it is difficult to explain the phenomenon which is probably due to a number of factors such as the life span of *Nassa*, migrations of the definitive hosts. Five new species of *Cercaria* are described. G. M. F.

Cestoda.

Cestodes from Belgian Congo.—J. G. BAER ("Sur quelques cestodes du Congo Belge," *Rev. Suisse de Zool.*, 1925, **32**, 239–251, 10 text-figs.). An examination of material sent home from Africa; unfortunately the only information as to host was the native names, and it has been impossible in most cases to identify these. New species described are *Hymenolepsis dodecantha*, from a shrew, and presenting some features resembling *H. scalaris*, but only half as long; *H. globirostris*, from a rat, 80 mm. long and possessing 12–14 hooklets; *Catenotenia lobata*, from another rat, but too badly preserved for detailed description, though the excretory system is said to be highly characteristic and widely different from the two others of the same genus; *Cotugnia parva*, from a native crow; *Raillietina* (*Skrjabinia*) *cryptocotyle*, from an unknown bird. Some previously known species are undescribed. J. F. C. H.

Tapeworms of the Domestic Fowl.—F. J. MEGGITT (*J. Burma Res. Soc.*, 1926, **15**, 222–243, 5 pls.). The cestode fauna of Burma is very rich, and fowls are found to be heavily infected. Owing, however, to the poor general condition of the birds, no definite knowledge of the symptoms and methods of cure are available. On examination of 40 fowls from Rangoon, all were found to be infected, the number of worms varying from 10 to several thousand. Three new species were met with. An analysis of the tapeworms of 13 fowls showed *Raillietina tetragona* and *Hymenolepis rustica* to be the commonest forms; *Amabotania sphenoides* and *Cotugnia digonopora* were comparatively rare. This is the opposite of what occurs in England where *A. sphenoides* and *D. proglottina* are common, and *Raillietina* occurs only very exceptionally. A description of the three new species—*R. birmanica*, *R. pseudoechinobothrida*, and *Hymenolepis rustica*—and of the tapeworms previously recorded from fowls follows, and the paper concludes with a key to the adult tapeworms of fowls. J. L.

Coelenterata.

Hydrozoa.

Axial Gradients in Hydrozoa.—L. H. HYMAN ("Respiratory differences along the Axis of Tubularia, with some Remarks on Regeneration Rate," *Biol. Bull.*, 1926, **50**, 406–426). The rate of oxygen consumption per unit volume of cœno sarc is greater in apical than in basal halves of distal regions of the stem of *Tubularia*, and is greater the younger the stem. The time between cutting and completion of oral hydranths is shorter the more apical the piece in pieces of equal length from distal levels of the stem of *Tubularia*. The time between cutting and completion of oral hydranths is independent of the length of the piece when the apical end of the pieces is taken at the same level, except in very short pieces. In general there is a relation between respiratory rate and regeneration. The

higher the respiratory rate the shorter is the time interval between cutting and completion of oral hydranths and the larger is the size relatively or absolutely of the regenerated oral hydranth.

G. M. F.

A Fresh-water Hydro-medusan.—F. PAYNE ("Further Studies on the Life History of *Craspedacusta ryderi*, a Fresh-water Hydromedusan," *Biol. Bull.*, 1926, **50**, 433-443, 9 text-figs.). A detailed description of the development of the egg into the hydroid is given. The first cleavage is equal, but after this inequalities begin. Continued cleavage results in the production of a blastula, the cells of which are long, pointed at the inner ends and larger at the peripheral ends. The method of endoderm formation is similar to the process in other Hydromedusæ. The systematic position of *Craspedacusta* is discussed at length.

G. M. F.

Hydra viridis.—W. A. KEPNER and J. B. LOOPER ("The Nutrition of the Ovum of *Hydra viridis*," *Biol. Bull.*, 1926, **50**, 525-530, 3 text-figs.). The nutrition of *Hydra viridis* is a dual process. The first phase has reference to the nutrition of an oögonium of the final generation. This oögonium is nourished through the disintegration and resorption of adjacent interstitial cells. Through this nourishment the final oögonium grows into a large pseudopodial cell the primary oöcyte. The first nutritional phase is referred to the growth of the final oögonium into a primary oöcyte. It does not involve yolk-formation. The second phase of nutrition begins with the primary oöcyte lying, as a pseudopodial cell, in extended relation to the endoderm. Yolk is elaborated by the oöcyte from material handed over by the endoderm and the protoplasm of interstitial cells is not involved. The second nutritional phase is referred to the development of the zygote.

G. M. F.

Medusæ of Mutsu Bay.—T. UCHIDA ("Report of the Biological Survey of Mutsu Bay.—2. Medusæ of Mutsu Bay," *Sc. Rep. Tôhoku Imper. Univ.*, 1927, **2**, 215-238, 10 text-figs.). This is a systematic account of the medusæ collected in Mutsu Bay (Japan) during three years, 1924-1926. Twenty-two species are described, 14 belonging to the Hydromedusæ, 6 to the Scyphomedusæ, and 2 to the Ctenophoræ.

J. F. C. H.

Protozoa.

Factors Causing the Opening of Amoeba Cysts.—A. LWOFF ("Le déterminisme du dékystement des amibes d'eau douce: rôle des variations de la pression osmotique," *Compt. rend. Soc. Biol.*, 1927, **96**, 989-91). Cysts of an amoeba (*Hartmanella* sp.) were found to open only after dehydration, and reimbibition. Cysts when returned to water after prolonged desiccation, even of several months, germinate rapidly. The most convenient method of dehydration is by immersion in an osmotic solution. The cyst wall is semipermeable, and water is immediately lost, to be reimbibed when the cysts are returned to a normal medium. In this way all the cysts are subject to the same degree of dehydration, and the degree can be measured. There is a minimum of dehydration necessary to induce germination; solutions of NaCl. of less than 1 p.c. have no effect.

S. D. K.

New Species of Cycloposthium.—A. M. DA CUNHA and J. MUNIZ ("Trois nouvelles espèces du genre *Cycloposthium*," *Compt. rend. Soc. de Biol.*, 1927 **96**, 494-6, 3 text-figs.). The author describes three new species of *Cycloposthium* from the cæcum and large intestine of *Hydrochærus capibara*. *C. magnum*

n. sp. has a barrel shaped body, measuring 300 to 400 by 200 to 220 μ , with an anterior peristome, and a sac-like posterior process, at the base of which are two caudalia. The alveolar layer is fairly well developed. Macro- and micronucleus are elongated, the former curved posteriorly, the latter is situated near its anterior end. *C. cristatum* n. sp. has a flat slightly convex body, measuring 270 to 320 by 250 to 270 μ , obliquely truncated anteriorly, and with an irregular posterior process. The alveolar layer is greatly developed, forming a lateral crest. The caudalia are formed of rows of cilia. The macronucleus, on the side of the body away from the alveolar crest, is long, and curved anteriorly, the micronucleus small and oval. *C. caudatum* n. sp. is flat, roughly triangular, and measures 240 to 270 by 140 to 150 μ . The alveolar layer is greatly developed, forming a crest both lateral and posterior, and interfering with one of the caudalia, which is a tuft, while the opposite one is a row of cilia. The macronucleus is long and curved anteriorly, the micronucleus small and round. S. D. K.

Reserve Materials of Fœttingeriidae.—E. CHATTON, M. PARAT, and A. LWOFF ("La formation, la nature, et l'évolution des réserves chez *Spirophrya*, les *Polyspira*, et les *Gymnodinioides* (Infusiores Fœttingeriidae)," *Compt. rend. Soc. Biol.*, 1927, 96, 6-8). In *Spirophrya* the reserve material elaborated in the central vacuole during the trophic phase is largely composed of a vitelloid substance, giving a positive Derrien-Turchini reaction. The reaction with Millon's reagent is negative. It also contains cholesterin and glycogen. Refrangent granules, probably lipid in nature, occur in the cytoplasm. All these inclusions are distributed among the daughter cells at multiplication, and used up in the encysted stage. In *Polyspira* and *Gymnodinioides* the fate of the central mass is similar. It is largely composed of vitelloid, and is rich in glycogen. In *Polyspira* from *Pagurus prideauxii*, the proteid of the central mass is in combination with a carotinoid which gives it a mauve tint. In digestion it is separated off, the carotin being left free in the cytoplasm, and eliminated when the cysts break. S.D.K.

Enteromonas intestinalis Fonseca.—A. M. DA CUNHA and J. MUNIZ ("Sur la division de l'*Enteromonas intestinalis* (Fonseca)," *Compt. rend. Soc. de Biol.*, 1927, 96, 479-81, 5 text-figs.). *Enteromonas intestinalis*, from the cæcum of *Oryctolagus cuniculus* L. has a rounded body measuring 7 by 5-7 μ , alveolar endoplasm, and an anterior nucleus, with a large karyosome. Three flagella, the longest of which is trailing, arise from a basal granule connected by a rhizoplast to the nucleus. At fission the basal granule divides independently of the nucleus; its two halves are at first joined by a centrodosome, which later disappears. In early stages of division one basal granule has three flagella, the other only two; later both have three. S. D. K.

Three New Intestinal Flagellates.—A. M. DA CUNHA and J. MUNIZ ("Sur les flagellés intestinaux; description de trois espèces nouvelles," *Compt. rend. Soc. de Biol.*, 1927, 96, 496-8, 5 text-figs.). *Enteromonas wenyoni* n. sp., from the large intestine of *Didelphys aurita*, is rounded, about 6 μ in diameter, with alveolar cytoplasm, and an anterior nucleus, which has an indistinct membrane, and a large karyosome. The basal granule, attached by a rhizoplast to the nucleus, gives rise to three flagella, one of which is recurrent. *Eutrichomonas aguti* n. sp. measures 4-7 by 2-3 μ , and occurs in the cæcum and large intestine of *Dasyprocta aguti*. The cytoplasm is alveolar, the cytostome small, and the nucleus ovoid and anterior. Near the latter are usually three basal granules, from which arise four flagella, one being recurrent. The axostyle, which is thick and tubular, and projects

posteriorly distinguishes this species from *E. caviae*, with which it was confused by da Fonseca. *Trichomonas megastoma* n.sp. from the cæcum and large intestine of *Cœndu villosus* F. Cuvier, has an ovoid body, measuring 7–10 by 3–4 μ ; the nucleus is anterior and compact; near it is a basal granule, with four flagella, one of which is recurrent, and edges an undulating membrane. Thus membrane is attached along one side, and the cytoplasm at its base stains more intensely than elsewhere. A parabasal filament is attached to the basal granule. S. D. K.

Enteromonas lagostomi, n. sp.—A. M. DA CUNHA and J. MUNIZ ("Description d'une nouvelle espèce d'enteromonas parasite du cæcum du *Lagostomus trichodactylus* (Brookes 1829)," *Compt. rend. Soc. de Biol.*, 1927, **96**, 478–9, 3 text-figs.). *Enteromonas lagostomi* n. sp. occurs in the cæcum of *L. trichodactylus*; the body is rounded, 3.5–4.5 μ in diameter, with clear rather alveolar cytoplasm; the nucleus, the diameter of which is about one-third that of the body, is compact and anterior. Three flagella, one recurrent, arise from an anterior basal granule which is connected to the nucleus by a rhizoplast, and may be double. This species differs from *E. caviae* in the presence of the rhizoplast, and the position of the nucleus, which is not invariably peripheral. *E. fonsecai*, described from *Cavia* by Yakimoff in 1926, seems to be identical with *E. caviae*, first described by Lynch in 1922. S. D. K.

New Species of Cycloposthium.—A. M. DA CUNHA and J. MUNIZ ("Sur quelques ciliés parasites des mammifères du Brésil," *Compt. rend. Soc. de Biol.* 1927, **96**, 492–3, 2 text-figs.). Two new species of *Cycloposthium* are described from the cæcum and large intestine of *Hydrochaerus capibara*. *C. minutum*, n. sp., has a flat body, measuring 60–75 by 40–45 μ , with a constriction towards the posterior end, in which the two tuft-like caudalia are placed. Behind this the body is rounded and narrow. The peristome is anterior, and the alveolar layer hardly developed. The macronucleus is lateral, long, and straight, the small micronucleus lying near it. *C. vorax* n. sp. is flat with convex edges, obliquely truncated anteriorly, and measures 300–420 by 290–250 μ . The posterior end is rounded, and near it are two depressions, in which are the caudalia, formed of rows of membranellæ. The shape is often altered by ingested particles. The peristome is anterior, and obliquely placed, the alveolar layer almost absent. The macronucleus is long, its anterior end dilated and incurved; the micronucleus is very small. S. D. K.

Spores of Porospora in Gastropods.—P. HATT ("Spores de Porospora (Nematopsis) chez les gastéropodes," *Compt. rend. Soc. de Biol.* 1927, **96**, 90–1). Resistant *Nematopsis* spores of *Porospora*, previously described with certainty only from Lamellibranchs, are noted by the present author from *Trochocochlea*, *Phorcus*, *Gibbula*, *Pisania*, *Cerithium* and other gastropods. The spores occur in the lacunæ of the gills and liberate their sporozoites in the intestinal fluid of various crustaceans. These sporozoites can be distinguished from those of the *Nematopsis* of *Cardium*, but seem to be identical with those of *P. galloprovincialis*. The infested gastropods live with *Mytilus galloprovincialis* in the littoral zone, and seem to act as alternative hosts for the parasite, which affects several lamellibranchs. Gastropods can be infected easily with gymnosporos of *P. galloprovincialis* from crustacea; these enter the ctenidium direct, and have never been found in the gut. S. D. K.

Genera of the Sub-Family Eimeriinae.—C. PINTO ("Sur les genres de la sous-famille des Eimeriinae (Sporozoa, Eimeriomorpha)," *Compt. rend. Soc. de*

Biol. 1927 96, 488-9). The diagnosis of the sub-family *Eimeriinae* Wenyon is given as follows: Oocysts of various shapes, containing four spores of variable morphology, each with two sporozoites. The following genera are included in the sub-family: *Eimeria*, *Bananella*, *Crystallosopra*, *Jarrina*, and *Mitrocystis* n. gen. The last includes only *Coccidium mitrarium*, described by Laveran and Mesnil from Chelonuans in 1902. This genus is defined as *Eimeriinae* with mitre-shaped oocysts ornamented with conical projections; four ovoid spores. Type species *M. mitra* (Laveran and Mesnil). S. D. K.

Cytoplasmic Inclusions of Haemoproteus.—PH. JOYET-LAVERGNE ("Sur les éléments cytoplasmiques d'une Hæmosporidie, *Hæmoproteus colombei*," *Compt. rend. Soc. de Biol.* 1927, 96, 860-1). Two types of adult *H. colombei* are described; in one (A type) the nucleus is small and well defined, and the cytoplasm stains well with Giemsa. This type is considered to be female, type B, in which the cytoplasm has little affinity for Giemsa, male. In both types three categories of granules are described, forming, with the melanin grains, a mosaic in the cytoplasm. The first are lipid granules, similar in both types, but best defined in A. The second are paraglycogen grains, which are similar in size to the lipoids in A; in the B type some of these are very large, and have a stainable centre as in Gregarines and Coccidia. The third type of cytoplasmic granule is chromatic, and probably albuminoid, the same size as the others in the A type, but larger in the B. Thus *Hæmoproteus* corresponds very closely with the Coccidia in its cytoplasmic constitution. S. D. K.

Cytology of Trichonympha Chattoni.—O. DUBOSCQ and P. GRASSÉ. ("Sur la division mitotique de *Trichonympha Chattoni* (Dub. et Grassé)," *Compt. rend. Soc. Biol.* 1927, 96, 92-4.) The parabasal of this flagellate consists of 32 to 44 chromophil-chromophobe strands, in a corona round the nucleus. Colourless spherules originate in these and fall into the cytoplasm. There are 14 or 16 chromosomes, and a spherical endosome. The chromosomes show distinct chromomeres in the prophase, and split longitudinally; the "rostre" divides, but does not act as a centro-blepharoplast. Asters are present. In metaphase the chromosomes become dense, and the endosome seems to divide. The parabasal strands are shared between the daughter cells. Mitochondria are present at all stages, and a mitochondria-free space shows the beginning of cytoplasmic division. The daughter individuals have a reduced flagelliferous zone, and seem to have been mistakenly classified as a separate genus, *Leidyopsis*. S. D. K.

A Factor of Encystment in Amœbæ.—E. WOLFF ("Un facteur de l'enkystement des amibes d'eau douce. Prolongation expérimentale de la période végétative," *Compt. rend. Soc. de Biol.* 1927, 96, 636-8, 1 text-fig.). Encystment in amœbæ is not due to an internal need, but to external conditions, and if these conditions are averted, cultures can be kept for prolonged periods without encystment. One factor causing encystment is inanition, as from lack of food. When the nutritive medium in which a pure mixed culture of an amœba (*Hartmanella* sp.) and a bacterium was growing was replaced by distilled water, the amœbæ soon encysted, except in patches where some bacteria, adhering to the culture tube, formed a food supply. Control tubes, in which the nutritive medium was not removed, showed no encystment. S. D. K.

Influence of pH on Infusorian Cultures.—L. MOREA ("Influence de la concentration en ions H sur la culture de quelques infusoires," *Compt. rend. Soc. de Biol.* 1927, 97, 49-50). pH is important in culture and reproduction of Infusoria,

but there may be several optimum concentrations for a given species; the optima may be alkaline (*Paramœcium*), neutral (*Spirostomum*), or both acid and alkaline (*Colpoda*). Fasting *Paramœcium* show less resistance to acid or strongly alkaline concentrations. In normal conditions the alkaline pHs acidify, the acid ones alkalize, and all evolve towards a common pH (7.5–8.5). S. D. K.

Cytology of *Opalina ranarum*.—J. SOKOLSKA ("Sur les composants lipodifères du plasma du protozoaire parasite *Opalina ranarum* (Purk. et Val.)," *Compt. rend. Soc. de Biol.* 1927, **96**, 570–2, 3 text-figs.). After chrome-osmium fixation disc-like Golgi elements are described in the endoplasm of *Opalina ranarum*. Their structure is homologized with that of the Nassonov contractile vacuole Golgi complex; an outer lipidiferous membrane forms a loop round an inner greyish substance, the *gebundenes Sekret* of Nassonov. The loop may break to two pieces, or become completely detached from the central substance (*freies Sekret* of Nassonov). If the animal strikes an obstacle, the Golgi bodies in this region lose their disc-like shape, and become irregularly rounded. Mitochondria are described as small granules, blackened by modified osmic techniques, which do not decolourise in turpentine; they stain characteristically by the Kull and Benda methods. They are arranged in a single row in each cilium, and are uniformly distributed in the endoplasm. S. D. K.

Culture of *Trichomonas*.—R. DESCHIENS ("Simplification du milieu de Boeck-Drbohlav pour la culture du trichomonas," *Compt. rend. Soc. Biol.* 1927, **96**, 13–4). Media of the Boeck-Drbohlav type can be simplified for the culture of *Trichomonas* by substituting 0.7 p.c. physiological water for the Ringer-Löcke liquid. This medium has been successfully used at 37° and 20° C., and gives a more abundant and longer lived culture than the original. S. D. K.

Adaptation of *Amœbæ* to Saline Solutions.—E. WOLFF ("Adaptations des amibes aux solutions salines. Kystes sans membrane," *Compt. rend. Acad. Sc.*, 1927, **184**, 1093–5). The addition of 0.5 to 4 p.c. NaCl to cultures of *Amœbæ* (*Hartmanella*, sp.) did not affect their vitality, but as the concentration of the solution is increased the membrane formed on encystment becomes thinner, till it disappears, the "encysted" forms still showing the usual characteristics of encystment, except that they are naked. These "cysts" resist desiccation like ordinary cysts, resistance being due apparently to a state of the protoplasm, not to the cyst membrane. When returned to ordinary cultures these *amœbæ* recovered the power of encystment. S. D. K.

Life Cycle of *Aggregata eberthi*.—A. NAVILLE ("Recherches sur le cycle sporozonique des *aggregata*," *Rev. Suisse de Zool.*, 1925, **32**, 125–179, 8 pl., 4 text-figs.). This fifty-page paper, describing the life-cycle of a protozoon which undergoes schizogony in a crab (*Portunus depurator*) and sporogony in a cephalopod (*Sepia officinalis*), covers much the same ground as Dobell's paper in "Parasitology," 1925, v. 17. The author concludes that his work along with that of Siedlecki and Dobell places the genus *Aggregata* among the Coccidia.

J. F. C. H.

Effect of pH upon *Amœba*.—D. L. HOPKINS ("The Effect of Hydrogen-ion Concentration on Locomotion and other Life-processes in *Amœba proteus*," *Proc. Nat. Acad. Sci.*, 1926, **12**, 311–315, 1 chart). Observations were made on the influence of the change of hydrogen-ion concentration upon *Amœba proteus* cultivated in infusions the reactions of which varied from acid to alkaline. It was found that there were two optimum reactions for growth: one around pH 6.7,

the other around pH 7.6. Solutions near neutrality, or strongly acid or alkaline, are unfavourable. There is a decrease in the rate of locomotion when the amoebæ are transferred from slightly alkaline or acid solutions to a neutral solution.

C. A. H.

Transmission of Piroplasmosis.—J. LEGG ("Can the Cattle tick, *Hæmaphysalis bispinosa*, act as the carrier of Piroplasmosis (*Piroplasma bigeminum*)?" *Austr. Jl. Exper. Biol.* 1926, 3, 203-216). Experiments were carried out with the view of testing the possibility of *Piroplasma bigeminum* being transmitted by *Hæmaphysalis bispinosa* in New Zealand. Cattle-ticks in various stages of development fed on an infected animal and then allowed to feed on susceptible animals failed to convey the disease. When subsequently inoculated with the virulent blood the cattle experimented upon acquired an infection. The experiments point against the tick being concerned in the spread of bovine piroplasmosis.

C. A. H.

Viability of Infusoria.—T. B. ROBERTSON ("On Some Conditions affecting the Viability of Cultures of Infusoria and the Occurrence of Allelocatalysis therein," *Austr. Jl. Exp. Biol.* 1927, 4, 1-23). The rate of reproduction of ciliates in a culture increases with the density of population. This is due to allelocatalysis, or mutual acceleration of reproduction by contiguous cells. It has not been established whether the allelocatalytic effect originates with the ciliates or with associated bacteria. The effect is presumably due to some soluble substance emitted by the organisms in culture. Subcultures of *Enchelys* are unable to tolerate the temperature of 30° C., unless the parent-culture is previously cooled to 4° C. or allowed to stand at room temperature for 24 hours. The optimum reaction of a culture is between pH 8.0 and 8.3. *Enchelys* is able to survive in hypertonic solutions containing M/12 NaCl for 48 hours.

C. A. H.

Structure of Protoplasm in Amoeba.—(1) S. O. MAST ("The Structure Movement, Locomotion and Stimulation in Amoeba," *Jl. Morph. & Physiol.* 1926, 41, 347-425, 10 text-figs). (2) S. O. MAST ("The Structure of Protoplasm in Amoeba," *Amer. Natur.* 1926, 60, 133-142). The body of *Amoeba proteus* consists of a central fluid portion (plasmasol), a rigid layer surrounding this (plasmagel) and a thin elastic surface layer (plasmalemma). The plasmasol is an emulsion and is hypertonic, while the plasmagel is alveolar, and the plasmalemma probably consists of a meshwork of protein fibres and a lipid filling the interstices. The two last-named layers are semi-permeable and are capable of being stretched by an excess inflow of water. Part of the plasmagel liquefies, with the result that a pseudopodium is formed. Locomotion in *Amoeba proteus* is due to the following: (1) Hypertonic solution (plasmasol) surrounded by a semi-permeable membrane (plasmagel and plasmalemma) or other conditions resulting in turgidity. (2) Local swelling of the plasmagel at the tip of the . . . pseudopods with decrease in elastic strength. (3) Contraction in the rest of the plasmagel with liquefaction on the inner surface at the posterior end resulting in forward flow of the plasmasol. (4) Gelation of plasmasol . . . forming new plasmagel. (5) Adhesion of the plasmalemma to the substratum and to the adjoining plasmagel." C. A. H.

Reactions to Light.—S. O. MAST ("Reactions to Light in *Volvox*, with special reference to the process of Orientation," *Zeitschr. vergl. Physiol.* 1924, 4, 637-658, 7 text-figs.). *Volvox* rotates on the longitudinal axis as it swims through the water, its flagella beating diagonally backward. If the intensity of the light falling upon photopositive colonies is suddenly decreased the stroke of the flagella

becomes directed backward, with the result that the colonies stop rotating and "spurt directly forward." If the intensity is increased, locomotion stops and the rate of rotation increases, the stroke of the flagella changing from diagonal to nearly sidewise. Photonegative colonies react in a similar manner except that the effect of varying intensity of the light on the direction of the stroke of the flagella is reversed. "The eye-spots in *Volvox* consist of a pigment-cup, a lens which is located at the opening of the cup, and photosensitive substance which is located in the cup. There is one in each zooid, and all face outward." Photoc orientation is brought about by changes in the direction of the stroke of the flagella. These changes cease after the colonies are oriented, when they tend to take a straight course. Any tendency to swerve from this course leads to unequal illumination of opposite sides. The change of intensity on the photosensitive substance in the eyes then leads to reorientation. C. A. H.

Encystment in Didinium.—(1) C. D. BEERS ("The Life-cycle in the Ciliate, *Didinium nasutum*, with reference to Encystment," *Jl. Morph. & Physiol.*, 1926, 42, 1-20, 2 charts). (2) C. D. BEERS ("Encystment and the Life-cycle in the Ciliate, *Didinium nasutum*," *Proc. Nat. Acad. Sci.*, 1925, 11, 523-528.) (1) Three pure lines of *Didinium nasutum* were maintained in isolated cultures with an abundant supply of food (Paramecium). No decrease in the fission rate or increase in the encystment or death rates were observed for 457-786 generations. Three pure lines forming another group were cultivated simultaneously, the food being limited to nine paramecia per diem. The fission rate of these lines decreased and the encystment and death-rates increased. In a culture fed on six paramecia daily encystment commenced much earlier. It is concluded that "there is nothing in the nature of a definite life-cycle in Didinium and that diminished vitality and encystment do not result from passage of generations, but result from inadequate and unfavourable cultural conditions." Encystment can be regulated by varying the quantity of food.

(2) The first part of this paper covers the same ground as the preceding work. It is also shown that—(a) the rate of encystment in Didinium increases in the absence of food; (b) the ciliate does not become more predisposed to encystment as the age of the culture increases; (c) ciliates that have passed through several hundred generations without conjugation or encystment show the same percentage of encystment as those which have passed through a few generations since conjugation; (d) the excretion products of Paramecium inhibit the encystment of Didinium; (e) the excretion products of Didinium favour its encystment; (f) the maximum encystment takes place between pH 6.4 and 8.0; (g) the percentage of encystment increases with the age of the hay-infusion in which Didinium is cultivated. C. A. H.

Transmission of Trypanosoma equiperdum.—E. IWANOW and F. MESNIL ("Le trypanosome de la dourine traverse-t-il la peau ou les muqueuses saines?" *Ann. Inst. Pasteur*, 1927, 41, 507-512). The authors have established experimentally that *Trypanosoma equiperdum* is unable to penetrate through the intact skin and mucous membrane of the vertebrate host. Under natural conditions the infection is transmitted through abrasions of the genital parts of the horses during the sexual act. In districts where dourine is prevalent substitution of artificial insemination for the natural coitus is recommended. C. A. H.

Bovine piroplasmosis.—E. SERGENT, A. DONATIEN, L. PARROT, F. LESTO GUARD et E. PLANTUREUX ("Les piroplasmoses bovines: la 'fièvre de la côte orientale' et la theilériose nord-africaine," *Ann. Inst. Pasteur*, 1927, 41,

489-506). The authors have made a comparative study of two species of cattle-piroplasms, *Theileria parva*, the parasite of "East Coast fever" in East and South Africa, and *T. dispar*, of Algeria. The clinical and pathological symptoms of the two forms are indistinguishable, but an animal recovered from an infection with one species does not acquire immunity to the other. There is some difference between the intracellular stages of the two forms: the proportion of rod-shaped forms in *T. parva* is considerably greater than in *T. dispar*, the former also being richer in chromatin than the latter. It was also found that *Rhipicephalus appendiculatus*, the intermediate host of *T. parva*, when fed on *T. dispar* is unable to convey the disease to cattle (xenodiagnosis). It is concluded that the specific difference between the two parasites is well established. C. A. H.

Cultivation of Lacrymaria.—Y. IBARA ("Culture Medium for the Ciliate *Lacrymaria*," *Science*, 1926, 63, 212). *Lacrymaria* grows best in cultures containing malted milk in the proportion of 3 mg. per 100 cc. water. C. A. H.

Nassula.—E. McNALLY ("Life-cycle of *Nassula ornata* and *Nassula elegans*: Are these species valid?" *Biol. Bull.* 1926, 51, 237-245, 1 pl.). "*Nassula ornata*" and "*Nassula elegans*" represent not two species, but two metabolic stages of a single species. The well-nourished phase, known as "*Nassula ornata*," does not encyst. Lack of food first converts "*Nassula ornata*" into "*Nassula elegans*," and in time drives the forms as "*Nassula elegans*" into encystment. Binary fission occurs more frequently in the poorly fed than in the well-nourished forms. There is but one nucleus in this ciliate, there being no differentiation of the nuclear complex into micro- and macro-nuclei. Conjugation involving this single nucleus takes place in stocks that have aged. G. M. F.

Studies of Paramoecia.—K. M. HANSEN ("Some Studies of Paramoecia, concerning their Isolation, Sterilization and Nutritive Requirements," *Acta Path. and Microbiol. Scandinavica*, 1927, 4, 1-38). A "trap" has been devised for a rapid washing of paramoecia which will almost completely free them from the bacteria which are present in the hay infusion. The influence of various salts and amino acids upon the life-time of paramoecia has been tested and, as a rule, an optimum concentration is usually found, the favourable influence of which must no doubt be ascribed to other factors besides osmotic conditions. Hay infusion, autoclaved for six hours, affords a favourable culture medium for paramoecia, giving growth in a large percentage of the inoculated tubes, while short autoclaving gives a low growth percentage. This result is ascribed to a favourable preparation of the nutritive elements in the hay which supply the calories; whether this advantage is directly utilized by the paramoecia or whether it is obtained through the agency of bacteria could not be settled. Certain substances, e.g., the content of freshly killed paramoecial bodies or freshly evacuated spinal fluid may be utilized as a vitamin source for paramoecia, but the presence of live bacteria seems to be requisite.

Prolonged autoclaving of diluted milk may improve the milk as a nutrient medium for paramoecium while short autoclaving destroys it; if raw milk be used as a medium it must be fresh. G. M. F.

Endamoeba citelli, sp. nov.—E. R. BECKER ("*Endamoeba citelli* sp. nov. from the striped ground squirrel *Citellus tridecemlineatus* and the life history of its parasites, *Sphaerita endamoebae*, sp. nov.," *Biol. Bull.*, 1926, 50, 444-454, 1 pl.). A new species of *Endamoeba* is described from the caecum of the ground squirrel, where it appears to be a commensal. The nucleus is of the vesicular type with

a deeply staining karyosome. The eight nucleate cysts have walls of about one micron in thickness. The cytoplasm of the cyst is granular and the nuclei are characterized by the presence of a number of irregular deep-staining blots.

A cylindine parasite, *Sphaerita endamoebae* sp. nov. is described which is mildly pathogenic to the amoeba, the ill-effects of parasitism being manifested by abnormal nuclear appearances. The developmental cycle of this cytozoic parasite was followed from the free bacterium-like infective stage to the spore liberated from the sporangium inside the cytoplasm of the amoeba.

G. M. F.

Development of Chinese Leishmania.—W. S. PATTON and E. HINDLE ("The Development of Chinese *Leishmania* in *Phlebotomus major* var. *Chinensis* and *P. Sergenti* var.," *Proc. Roy. Soc. B.*, 1927, **101**, 369–390). *Phlebotomus major* var. *chinensis* is a favourable host for the development of the *Leishmania* of Chinese Kala Azar as shown by feeding experiments on infected hamsters. When a fly is infected the flagellates attach themselves to the lining of the mid-gut and grow forward, passing into the pharynx and buccal cavity after about six days. Once infected this species of sandfly seems to remain so for the duration of its life (10 to 12 days) irrespective of whether or not it is refed. In the case of *P. sergenti* infection was restricted to the broad posterior region of the mid-gut and were never found in the oesophagus.

G. M. F.

Division in Amoeba.—L. A. PHELPS ("Experimental Analysis of Factors concerned in Division in Amoeba," *Trans. Amer. Micr. Soc.*, 1926, **45**, 133–145). Division in *Chaos diffuens* seems to be a direct result of increase in size of the cytoplasm and at the same time the rate of growth is definitely retarded by the act of excision and consequent regeneration. The less rapid growth of cytoplasm in the regenerating amoebæ as compared with the controls is probably due to interference by the reorganization processes of the nucleus in the regenerating amoebæ. The act of excision only temporarily (a few seconds) incapacitates amoebæ, which probably represents the time occupied in wound healing. Enucleated amoebæ are incapable of carrying on any body processes except locomotion. The minimal reorganization mass obtained thus far in the experiments is one-eightieth as large as the normal amoebæ. Starved amoebæ show excessive accumulation of crystals, a phenomenon accompanied by absence of division.

G. M. F.

Rôle of Nucleus in Cell Functions.—E. R. BECKER ("The Rôle of the Nucleus in the Cell Functions of Amoebæ," *Biol. Bull.*, 1926, **50**, 382–392, 1 pl.). Enucleated amoebæ of the species *Amoeba dubia* show the following properties. Within a few minutes after enucleation streaming ceases and the amoeba becomes a wrinkled sphere. The streaming is resumed in a few hours and is usually of the limax type, though it may approximate the normal. Enucleated amoebæ may attach themselves to the substratum. They are irritable, but do not show the same response to stimuli that nucleated amoebæ do. Food organisms which enter the body of an enucleated amoeba are killed and digested in an apparently normal manner.

G. M. F.

CORRIGENDUM.

The abstract "A Fresh-Water Ostracod," on page 166, should read H. G. CANNON ("On the Feeding Mechanism of a Fresh-Water Ostracod, *Pionocypris vidua*," Muller).

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology.

Chromosomes in Tulipa.—W. C. F. NEWTON ("Chromosome Studies in Tulipa and some Related Genera," *Journ. Linn. Soc.*, 1926, **47**, 339-354, 4 pls. 1 text-fig.). An investigation as to the early development of the embryo-sac with special reference to the classification of species. The characteristic number of chromosomes in *Tulipa* is twelve, while diploid, tetraploid and hexaploid varieties and species are known. The diploid chromosomes show great variation in size with a corresponding difference in the size of the nucleus. *T. galatica* Fresn. has 16 chromosomes, four of which are minute and in closely allied species absent. Transverse fragmentation probably accounts for the increased number of chromosomes. Different species show variation in form or relative size of the chromosomes. Most species agree with *Lilium* and *Fritillaria* in having two pairs of chromosomes with submedian attachment. The doubtful position of *Calochortus* is emphasized by the number of chromosomes, which may be seven, nine or ten; the well-marked satellites together with differences in size and attachment make it possible to identify individual chromosomes in this genus. In *T. primulina*, *T. australis* and *T. orphanidea* synopsis involves lateral pairing of whole chromosomes, which split again later and each individual then splits longitudinally, ultimately giving a tetrad of four chromatids, which separate during mitotic division. The various forms of the tetrads in diakinesis are due to the alternate opening of reductional and equational splits. No cytological proof of crossing has been found. S. G.

Cytology of Celsia and Verbascum.—A. HÄKANSSON ("Zur Zytologie von Celsia und Verbascum," *Lunds Univers. Arsskr.*, N.F. Afd. 2, 21, No. 10 (1926), 1-50, 84 text-figs.). A study of the embryology of *Verbascum* and certain species of *Celsia*. Great similarity was observed in the development of the embryo-sac, the endosperm and the integument of the seeds in all the species studied. The embryo-sac develops as in other Scrophulariaceæ; the endosperm is cellular, transverse preceding longitudinal division in every cell. The mitotic nuclear divisions of the pollen-mother-cells are normal. Flower-buds in unfavourable positions exhibit numerous instances of degeneration in the anthers, such as bi-nucleate pollen-mother-cells, rudimentary or incomplete nuclear spindles, clustering of the chromosomes, etc. Four hybrids examined during metaphase showed conjugation of the chromosomes of the different gametes; the affinity of the homologous chromosomes resulted in the formation of many bivalents, and appears to indicate a close relationship between the two genera. The irregularities observed were hardly enough to indicate complete sterility. The Scrophulariaceæ appear to have a serial number of chromosomes—8, 16, 24, 32 and 48. Most of the species of *Verbascum* had 16 haploid chromosomes. *V. Ternstroemia* had triploid and *V. maurum* tetraploid chromosomes. Two species were found to have 15 and one species 18

chromosomes, but both cases appear to be due to abnormalities derived from 16 normal chromosomes. Most species of *Celsia* had 24 chromosomes, especially those belonging to the primitive groups *Neffleae* and *Mesantherae*. In the *Aulacospermae* and the *Macrantherae* the numbers varied, and they are probably more recent groups. The latter group had usually 17 apparently derived from species of *Verbascum* with 16 chromosomes, while the west Mediterranean types are related to *Celsia* with 24 chromosomes. One group of species in the *Mesantherae* differs from the greater number of *Celsia* species in having 20 chromosomes. All these species, with 17 to 20 chromosomes, are those which according to Murbeck are related to *Verbascum*. The origin of this decrease in the number of chromosomes is probably some abnormality during reduction-division. Studies of the so-called tri- and tetra-some mutants, which have doubled one or both of a pair of chromosomes, indicate that there may be a relationship between such differences of number and the formation of new species; there may be also a corresponding change in the structure of the chromosomes themselves in the species of *Celsia* and *Verbascum*.
S. G.

Inheritance in Maize-Seedlings.—M. DEMEREC ("Inheritance of Pale Green Seedlings in Maize," *Genetics*, 1925, 10, 318-344.) A study of the chlorophyll abnormalities in the pale green seedlings frequently found among self-fertilized varieties of maize. Five types were examined, and in all of them the xanthophyll and carotin were found to be practically normal, the differences being due to the variations in the chlorophyll. In type 1 there was insufficient chlorophyll for photosynthesis; in type 2 enough chlorophyll for photosynthesis, but the seedlings remained pale in colour until maturity; type 3 had sufficient chlorophyll, but died in the early seedling stage; type 4 was pale green in the early seedling stage, but the amount of chlorophyll increased with age; in type 5 the amount of chlorophyll decreased with age. In type 2 the 50 p.c. normal chlorophyll was linked with dwarf habit and inherited independently. In type 3 the 30 p.c. normal chlorophyll was linked with brown aleurone colour. In type 4 the 50 p.c. normal chlorophyll was inherited independently. In type 5 there was 80 p.c. normal chlorophyll.
S. G.

Structure and Development.

Reproduction.

Staminate Cone of Larix.—J. DOYLE ("Notes on the Staminate Cone of *Larix leptolepis*," *Proc. Roy. Irish Acad.*, 1926, 37, 154-169, 3 pls.). A study of the morphology of the microstrobilus of *Larix leptolepis*. Sufficient evidence has already been produced to support the theory that the primitive stamen of the Conifer and *Ginkgo* phyla was a symmetrical structure bearing numerous distal sporangia, i.e., a modification of a primitive reproductive branching system. By direct homology relationship can be traced between both the microstrobili and the megastrobili of the Conifers and the primitive strobilus of the *Cordaitanthus* type. The mesarch vascular bundle of the stamen of *Larix* with its transfusion tissue favours the view that this tissue is derived phylogenetically from centripetal xylem. The author considers that an intensive study of the microstrobili of Conifers would afford important evidence as to phylogeny.
S. G.

Ovule of Larix and Pseudotsuga.—J. DOYLE ("The Ovule of *Larix* and *Pseudotsuga*," *Proc. Roy. Irish Acad.*, 1926, 37, 170-180, 3 text-figs.). The completion of a preliminary note published in the previous year. The integument of *Larix* has "a large outgrowth, on one side only, of a rather slit-like mouth." This

outgrowth serves as a stigma and carries the pollen to the micropylar canal. In *Pseudotsuga* there are two unequal outgrowths, the larger of which corresponds to that of *Larix*, while the smaller one is merely auxiliary. In both genera stigmatic processes form hairs in which the pollen is entangled; these hairs line a deep depression which extends round the micropyle. The ovules of the two species differ more than was formerly supposed, but there is ample evidence that the two genera are more closely connected in every morphological aspect except habit, than any other two of the Abietineæ. This is especially shown by the wingless pollen, the ovule, the female gametophyte and the secondary wood. S. G.

CRYPTOGAMS.

Pteridophyta.

Phylogeny of Ferns.—F. O. BOWER ("The Ferns (Filicales) Treated Comparatively with a View to their Natural Classification. Vol. II. The Eusporangiata and other Relatively Primitive Ferns," *Camb. Univ. Press*, 1926, pp. i-v, and 1-344, 1 pl., and figs. 310-580, 4 maps and diagram). The introduction of this volume is a summary of the contents of Vol. I, which appeared in 1923, including a re-statement of the twelve leading characteristics which the author would choose for the foundation of a *natural* classification of the ferns. It is found that the results of palæontological inquiry tend to run parallel with those of comparative anatomy. The following families are considered to be the most ancient, the Cœnopteridaceæ and Osmundaceæ, the Marattiaceæ and Ophioglossaceæ—and they include the existing eusporangiate ferns. The leptosporangiate ferns appear to be of kin to two relatively primitive families, Schizæaceæ and Gleicheniaceæ, the former with marginal sori, the latter with superficial sori, giving rise respectively to the two main sequences of the Leptosporangiata. In the present volume the families are discussed in chronological order, the oldest fossil types being taken first. In the present state of knowledge, it is impossible to work out the true evolutionary history of the groups. The Marsileaceæ find a place in the series by reason of a structural relationship with the Schizæaceæ, though differing from the latter so markedly in their heterosporous and aquatic habit. A. G.

Calamarian Cone.—ISABEL M. P. BROWNE ("A New Theory of the Morphology of the Calamarian Cone," *Annals of Botany*, 1927, 41, 301-320). A discussion of a theory that in the primitive Equisetales the cones consisted of successive whorls of sporangiophores, possibly interrupted here and there by whorls of ordinary leaves, and that, in course of evolution, leaves, like those on the shoot below, more and more invaded the cone, until in *Calamostachys* and *Palæostachya* they came to be intercalated regularly between the whorls of sporangiophores and served to protect the developing sporangia. A. G.

Fern Prothallia.—DAVID M. MOTTIER ("Behaviour of Certain Fern Prothallia under Prolonged Cultivation," *Bot. Gaz.*, 1927, 83, 244-266, 1 pl. and 7 figs.). Some prothallia of *Osmunda Claytoniana* and *Mattuccia nodulosa* have been cultivated by the author for three to four years without being allowed to produce sporophytes. They branched dichotomously and by proliferations from the margins and surfaces. In older prothallia archegonia may be developed on both surfaces, while antheridia appear chiefly on small marginal proliferations. Sometimes archegonia are borne on small protuberances on the upper side of the midrib. The cell-walls in older parts of the midrib are relatively thick and pitted. In the older midribs of *Osmunda Claytoniana* an endophytic fungus occurs

here and there. In *Matteuccia* a spinelike process forms near the growing point in a few prothallia, but dries up as growth proceeded. Apogamous sporophytes did not develop in any case. If sporophytes are not produced, the continuation shoots of the prothallia seem capable of indefinite growth. A. G.

Gametophyte of Ferns.—F. L. PICKETT and LEWIS A. THAYER ("The Gametophytic Development of Certain Ferns: *Polypodium vulgare* var. *occidentale* and *Pellaea densa*," *Bull. Torrey Bot. Club*, 1927, 54, 249-255, 3 pls.). A description of the methods of culture, the germination of the spores, the development of the protonema and of the prothallium, the production of antheridia and archegonia. It was rather surprising to find sporophytes arising by normal sexual method from the gametophyte of *Pellaea densa*, because in several other species of *Pellaea* apogamous production of sporophytes has been reported. It should be mentioned that for other reasons it has been thought better by some pteridologists to remove *P. densa* from the genus *Pellaea*. A. G.

Rhizome of Pteris.—C. Y. CHANG ("Origin and Development of Tissues in Rhizome of *Pteris aquilina*," *Bot. Gaz.*, 1927, 83, 288-306, 18 figs.). The structure of the rhizome of *Pteris* is strictly dorsiventral. The apical cell is of modified dolabrate type. The apical arrangement is adaptive to the subterranean habit. The endodermis and pericycle have a common origin, and both layers are stelar. The protophloem sieve-tubes and the phloem parenchyma are derived from a common mother cell, which, in turn, has a common origin with the mother cell of the endodermis and the pericycle. Protoxylem, metaxylem, wood parenchyma, and metaphloem, have been traced out by the author so far as possible. The development of xylem lags behind that of phloem in all except the lower peripheral bundles. The adventitious root develops extremely early; its apical cell arises in the outermost layer of the perome soon after differentiation of the periblem. The origin of the endodermis and adventitious root is found to have been incorrectly described in the older works. A. G.

Spanish Ferns.—JUSTO RUIZ DE AZÚA ("Nuevos datos pteridológicos para la flora española," *Bol. R. Soc. Española Hist. Nat., Madrid*, 1926, 26, 499-506, 1 text-fig.). An enumeration of 15 species of ferns collected in the Gascon provinces of Spain. Several of them are subdivided into subspecies and varieties; there are four subspecies and 56 varieties. A. G.

Bryophyta.

Cyathodium.—LALIT PRASAD KHANNA ("Cyathodium cavernarum Kunze from Burma," *Journ. Burma Research Society*, 1927, 16, 227-229, 1 pl.). An account of the morphology and reproduction of *Cyathodium* as found at Rangoon. Upon the following characters it is referred to *C. cavernarum* Kunze:—(1) Size of thallus; (2) presence of adventitious buds; (3) monœcious inflorescence; (4) size of sporogonium; (5) size of mature spores and elaters. A. G.

Riccia.—M. AROUINE CHESEBROUGH ("A Study of a Mexican Riccia," *Bot. Gaz.*, 1927, 83, 99-102, 6 text-figs.). A description of a species of *Riccia* collected at an altitude of nearly 7,000 feet on a very arid mountain near Guanajuato in Mexico, in a region where the streams are heavily charged with mineral salts. The structural peculiarities of this plant are three:—(1) ventral scales which closely invest the growing point; (2) tightly closed sex organ groove except at the front of the thallus; (3) a row of superficial cells, the plastids of

which break down into a mucilaginous substance, and the walls of which collapse upon the resulting lack of turgor, so that adjacent cells meet over the air spaces. These features serve to protect the plants from mechanical injury, and to conserve their moisture in so dry an environment.

A. G.

Jungermannia in Sweden.—H. WILH. ARNELL ("Die Schwedischen Jungermannia-Arten Pflanzegeographische Skizzen," *Arkiv för Botanik*, 1925, 19, pp 1-99, 7 pls.). A detailed account of the distribution in Sweden of the 40 native species of *Jungermannia* Micheli, which name he maintains as preferable to *Lophozia* Dumort. The subgenera are six: *Eusphenolobus*; *Tritomaria* Schiffn.; *Barbilophozia* Losska; *Dilophozia* K. Müll.; *Leiocolea* K. Müll.; *Gymnocolea* Dumort. The frequency of each species is indicated, also the presence of gemmæ, male or female inflorescence, or fructification, in the numerous specimens examined. The name of the first collector and the date of the first gathering are noted. By means of diagrammatic tables the county distribution of each species is shown at a glance.

A. G.

East African Hepaticæ.—WM. HY. PEARSON ("Notes on a Collection of Hepaticæ from Mount Elgon, East Africa, made by Dr. G. Lindblom in 1920," *Arkiv för Botanik*, 1925, 19, No. 5, 1-16, 11 pls.). An account of some East African hepaticæ collected on Mt. Elgon, comprising 19 species, nine of which are new to science, described, figured and critically discussed by the late W. H. Pearson. The novelties are three species of *Plagiochila*, three of *Taxilejeunea*, and one each of *Frullania*, *Marchesinia* and *Dicranolejeunea*.

A. G.

Mnium in Sweden.—HJALMAR MÖLLER ("Lövmossornas utbredning i Sverige, X, Mniaceæ," *Arkiv för Botanik* 1927, 21, A, 1-196, 50 text-figs.). A detailed account of the distribution in Sweden of the native species of *Mnium* (18) and *Cinclidium* (4), with keys, figures of areolation and leaf-margins, copious field-records, and diagrammatic tables which show at a glance the county distribution of each species and the principal varieties.

A. G.

Malayan Bryophytes.—TH. HERZOG ("Bryophyten der Weiteren Indomalaya (Ceylon, Sumatra, Borneo, Celebes, Molukken, Neuguinea)," *Hedwigia* 1926, 66, 337-358, 2 pls.). An account of the mosses and hepatics collected in the above-mentioned Malayan islands by missionaries, including descriptions of nine new hepatics and 24 new mosses. Two of the mosses from New Guinea are types of new genera: *Acantholoma* is allied to *Rhizogonium*, and *Crepidophyllum* is probably akin to *Vesicularia*.

A. G.

Thallophyta.

Algæ.

Trachelomonas.—PAUL VAN OYE ("Le Genre *Trachelomonas* au Congo-Belge," *Bull. Soc. Roy. Bot. Belg.*, 1927, 59, 164-185, 13 text-figs.). In 1925 the author published an account of the Flagellatæ of the Congo; he now monographs the species of *Trachelomonas* found in that river. He insists upon the importance of the shape of the capsule of the organism for the systematic determination of the species. The capsule may be nearly spherical, or ellipsoidal, or oviform, or almost polygonal. The species are separated into groups accordingly. Further, the surface of the capsule may be smooth, punctate, spiny, perforated, rugose, or warty. Further characters are derived from the buccal opening, the caudal

appendix, etc. The author records 33 species, nine of which are new to science ; also two varieties are described as new. A key to all the species, and keys to the species of each main group and to the rather numerous varieties of some of the species, are supplied.

A. G.

Pantosphaera.—A. R. ROSILLO ("La *Pantosphaera stagnicola* de Ginebra," *Bol. R. Soc. Española Hist. Nat.*, Madrid, 1926, 26, 485-488, text-figs.). An account of the cocco-lithophorid alga, *Pantosphaera stagnicola* Chodat et Rosillo, discovered in freshwater, in the environs of Geneva. The cell structure is described in detail and figured.

A. G.

Rangoon Algae.—S. L. GHOSE ("The Myxophyceæ of Rangoon, II," *Journ. Burma Res. Soc.*, 1927, 16, 220-26, 1 pl.). In 1926 Ghose described 20 of the commonest blue-green algæ found in Burma ; he now adds ten more species, and three new varieties, giving a description of each and some observations upon the usual habitat of the plant. The intention is gradually to publish as complete a record as possible of the Myxophyceæ found in Burmah. Several of the species are figured.

A. G.

Sulphur Algae.—KAARE MÜNSTER STRÖM ("Sulphur Algæ from Hungary," *Folia Cryptogamica*, Szeged (Hungaria), 1927, 1, 267-270). A list of 14 species collected by the late Prof. N. Wille in or by sulphur springs at Margit-sziget and at Herkulesfürdő, mostly from the latter place either in the water or on stones in hot steam. Seven genera are represented in the collection ; and the distribution of the species, most of them thermal, in other parts of the world is indicated.

A. G.

New Chlorophyceæ.—L. H. TIFFANY ("New Species and Varieties of Chlorophyceæ," *Bot. Gaz.*, 1927, 83, 202-206, 1 pl.). Descriptions of new algæ collected in the Wabash River in Illinois and Indiana, including a new species of *Spirogyra*, and two species and three varieties of *Oedogonium* which are new to science, with illustrative figures.

A. G.

Slime Formation in Desmids.—E. KOL ("Über die Bewegung mit Schleimbildung einiger Desmidiaceen aus den Hohen-Tátra," *Folia Cryptogamica*, Szeged (Hungaria), 1927, 1, 435-442, 2 pls.). An account of the movements and slime formation of various desmids. The material investigated was collected in streams and lakes on the Hohe-Tátra mountains. The observations were made on Indian ink preparations ; and movement began after a longer or shorter interval. The movements are much more lively in freshly collected and soon examined material than in cultures. Light exercises a potent influence upon the movement ; the movement is much slower in high than in low temperatures. Individuals of one and the same species exhibit different intensity of movement ; a comparative few will travel quite a long way ; others remain immobile. Thus individuality is a factor. The excretion of gelatin is not continuous but rhythmical, and locomotion is correspondingly interrupted. The track of *Spirotaenia* is zigzag. The gelatin excretion seems to be orientated almost with a conscious purpose, and is influenced by different factors. The individuals are very sensitive during excretion, and at a slight shake or the least touch lose their activity. Some 70 figures illustrate the movements described.

A. G.

Norwegian Mountain Algae.—K. MÜNSTER STRÖM ("Norwegian Mountain Algae. An Account of the Biology, Ecology and Distribution of the Algae and Pelagic Invertebrates in the Region surrounding the Mountain Crossing

of the Bergen Railway," *Norske Videnskaps-Akad. Oslo, Mat.-Nat. Kl.* 1926, 1-264, 25 pls.). This memoir, dedicated to the late Professor N. Wille, represents an extensive investigation for several years of the nature and ecology of the rich and varied algal flora of the mountains between Bergen and Oslo. The natural features of the region are described; the ecology, distribution, and environmental factors of the flora are discussed; followed by a systematic and ecologic account of the species collected. A bibliography of over one hundred papers, an index to the species and a series of plates complete the work. A. G.

Belgian Algæ.—H. KUFFERATH ("Liste de quelques algues et protistes récoltés en Belgique par feu le Dr. Henriquez," *Bull. Soc. Roy. Bot. Belg.* 1926, 59, 27-30. A localized list of algæ collected in various parts of Belgium in 1914, including eleven species and a genus previously unrecorded for Belgium. A. G.

Spanish Algæ.—PEDRO GONZALEZ GUERRERO ("Datos ficológicos de la Sierra de Cameros," *Bol. R. Soc. Española Hist. Nat., Madrid*, 1926, 26, 489-491). An enumeration of the algæ collected in June, 1925, on the Sierra de Cameros, in the provinces of Logroño and Soria, with notes as to frequency of occurrence. Seven species or varieties are new records for the Spanish flora. A. G.

Antheridium of Characeæ.—J. S. KARLING ("Variations in the Mature Antheridium of the Characeæ: A descriptive Study in Morphogenesis," *Bull. Torrey Bot. Club*, 1927, 54, 187-230, 5 pls. and 14 text-figs.). The Characeæ are strikingly regular and symmetrical in their development as a consequence of the simplicity of their cell structure. And this regularity has been regarded as extending also to the antheridia and oogonia. However, J. S. Karling finds a considerable number of variations from the typical structure of the antheridium, and classifies them into eight groups:—(1) In addition to primary and secondary capitula, tertiary and quaternary capitula are often formed, and these bear the antheridial filaments. (2) The number of primary capitula and manubria often varies; so many as 12 or 16 of the former have been found in a single antheridium. (3) The antheridial filaments often branch, occasionally five times. (4) The antheridial filaments are often irregularly septate. (5) The number of antheridial filaments borne on the secondary capitulum may vary. (6) The manubria, primary, secondary and tertiary capitula often form bud-like outgrowths. (7) The number of cells in an antheridial filament may vary considerably. (8) The cells and nuclei in the antheridial filaments may vary in size, and thus large and small antherozoids are formed. A. G.

Alternation in Ceramium.—NILS SVEDELIUS ("The Seasonal Alternation of Generations of *Ceramium corticatum* in the Baltic: a Contribution to the Periodicity and Ecology of the Marine Algæ," *Nova Acta Reg. Soc. Sci. Upsaliensis*, 1927, vol. extra-ord., 1-28, 1 text-fig.). An account of observations made during 1922-24 of the periodicity of *Ceramium corticatum*, Kyl., in the seasonal changes of the Baltic Sea, where, on the one hand, the winter ice has a great influence upon the littoral vegetation, and, on the other, there is a periodical variation of water-level, high in summer owing to melting snow and flooded rivers, and at its lowest in early spring: the tidal changes are very slight. The *Ceramium* produces tetraspores in the winter and sexual plants in the late summer. The plants become exposed to hard frost when the water-level falls in winter and may undergo wide destruction. Other plants survive the winter and set free tetraspores, which

germinate and produce sexual plants. The carpospores of the latter give rise to the tetrasporic plants of late autumn. Thus the alternation is established. The sexual plants are short-lived summer products. Some tetrasporic plants arise from paraspores borne on tetrasporic fronds. The seasonal alternation of generations in this and some other red algæ is very striking; in many other red algæ the alternation becomes obscured by the absence of synchronism and by the perennial persistence of the species.

A. G.

Bangiales of France.—GONTRAN HAMEL ("Floridées de France: Bangiales," *Revue Algologique*, 1924, 1, 278–292; 427–457, 7 text-figs.). This paper is also issued separately and repaged (1–46) as the first part of the Flore Algologue de France. It comprises descriptions of *Erythrotrichia* (6 species), *Porphyropsis* (1), *Porphyra* (2), *Bangia* (2), *Goniotrichum* (2), *Asterocytis* (1), as well as of some other genera which may yet be discovered on the coast of France.

A. G.

Algæ of Canary Islands.—F. BØRGENSEN ("Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. II. Phæophyceæ," *K. Danske Videnskab. Selskab. Biolog. Medd.* 1926, 6, 1–112, 37 figs.). An account of the brown algæ collected in the Canaries by the author, comprising 55 species in all, 22 of which are common to the West Indies and the Canaries. Among the more interesting plants are the peculiar *Nemoderma tingitana* of the Mediterranean, *Padina Vickersiæ* and two species of *Ectocarpus*, previously recorded for the West Indies. Also *Sporochnus Bolleanus*, *Aglaozonia canariensis*, *Zonaria lobata*, *Sargassum Desfontainesii*, have a similar distribution, the two latter species occurring also in South America. Many helpful drawings of structure are supplied in the paper, especially in illustration of the troublesome genus *Ectocarpus*.

A. G.

Fungi.

***Synchytrium endobioticum* (Schilb.) Perc.**—MARY D. GLYNNE ("Wart Disease of Potatoes: the Development of *Synchytrium endobioticum* in immune varieties," *Ann. Appl. Biol.*, 1926, 13, 358–9, 1 pl.). The method adopted of testing immunity in the laboratory was by placing living warts containing the summer sporangia of the fungus in close proximity with the young growing plant-shoots to be tested. Susceptible varieties were found to develop young warts in a few weeks. No warts were observed on immune varieties. On the surface of certain varieties, certified, however, as immune, small protuberances sometimes appeared on the shoots, but characteristic warts were not observed. Microscopic examination of these showed, however, infection by the *Synchytrium*, and a series had been formed containing summer sporangia. The tests are being continued; these summer sporangia are being used to infect other shoots, and research has been undertaken to discover the causes which may check the development of the parasite.

A. L. S.

Saprolegniaceæ.—W. C. COKER ("Other Water Molds from the Soil," *Journ. Elisha Mitchell Sci. Soc.* 1927, 42, 207–26, 10 pls.). In this paper Coker reports on work done under his direction by his class in mycology during five or six months. The first species described, *Achlya bisexualis*, was originally taken from a small pond and then grown on hemp seed or corn grain. Distinct heterothallism was observed; the second case reported in Saprolegniaceæ. Another case of heterothallism was proved in *Achlya* sp. not yet determined. *A. inflata*, n. sp., came from black soil under moss. A new genus *Brevilegnia* is distinguished

by a dense depauperate mycelium. Another new genus *Calyptralegnia* is peculiar in the multiple centric oospores with numerous small oil drops. The species, *C. achlyoides*, Coker and Couch, had been previously classified under *Thraustotheca*. The sporangium dehisces by the breaking off of an apical segment. A key is given of those members of the family of which the spores encyst within the sporangium, and a list is given of species found in the soil by members of the North Carolina University. The plates are clear and instructive. A. L. S.

Saprolegniaceæ and Spore Formation.—J. N. COUCH ("Some New Water Fungi from the Soil, with Observations on Spore Formations," *Tom. cit.* 227-42, 7 pls.). The writer describes his methods of collecting and isolating the moulds. The soil was placed in petri dishes and covered with water; hemp seeds were introduced and, after a few days, growth of the moulds was found to have occurred on all the seeds. Subsequent treatment is explained. In this research two new species of *Brevilegnia* were diagnosed, and another species *Geolegnia septisporangia* was studied in its growth and cytology. Lists are given of other species found in soil from Cold Spring Harbour, New York, during late winter and spring. Four species were secured from soil taken from the Blue Mountains, Jamaica, 3,500 feet elevation, during the summer. The plates are from microphotographs or from drawings. A. L. S.

New Species of Saprolegniaceæ.—JAMES VERNON HARVEY (*Brevilegnia dictina* n.sp. *Tom. cit.* 243-6, 2 pls.). The fungus was found both in dry and damp soil under very varied vegetation in fields and woods, and in widely scattered areas round Madison, Wis. Cultures were made—it grew well on various kinds of seeds or on bits of grains of rye and wheat. The most healthy growth was on buckwheat, where sporangia and oogonia were produced in abundance. Antheridia were formed, but were more often absent, and fertilization apparently does not take place. The various growth phases are depicted on the plates. A. L. S.

Phytophthora on Palms.—G. H. GADD ("The Relationship between the Phytophthoræ Associated with the Bud-Rot Diseases of Palms," *Ann. Bot.* 1927, 41, 253-80). The author has made an extended study of diseases of coconut palm generally designated as "Bud-rot" or as "Wilt." It is essential to understand the cause of the disease, as the final stage in the death of a coconut palm is usually a rotting of the terminal bud. It may be preceded by wilting of the leaves, and it has been suggested that bacteria cause the final rot though, according to Gadd, this is still unproved. Attention in this study centres on the parasitism of *Phytophthora*, as that fungus is certainly associated with bud-rot and other symptoms of disease in the palm. There is a lengthy discussion as to the species of *Phytophthora*, and a detailed account is given of cultures of the fungus and comparison is made with other species and strains. The only criteria useful in determination are the characters of the sexual organs, and these are frequently absent or fail to develop in the cultures. A complete bibliography adds to the importance of this study. A. L. S.

New Species of Pythium.—W. C. COKER and P. M. PATTERSON (*Journ. Elisha Mitchell Sci. Soc.*, 1927, 42, 247-50, 1 pl.). The new species, *Pythium torulosum*, appeared about March in cultures made from mosses and liverworts, when search was made for water moulds. The specific name refers to the torulose or conglomerate sporangial masses. The sporangia, few or many, are tuberous, and branched swellings much thicker than the hyphæ are cut off by septa when fully formed. Repeated cultures were made, but the form and manner of growth never

changed. Inoculations were made to test the ability of the fungus to induce damping off of seedlings; but no attack was induced. The mycelium grew about the hypocotyl and into the soil, but did not affect the seedlings. A. L. S.

Pythium Parasitic in Marchantia.—G. NICOLAS ("Sur un *Pythium* parasite du *Marchantia polymorpha* L.," *Bull. Soc. Mycol., France*, 1927, 43, 119-21, 1 text-fig.). The new species was discovered in the tissues of a sterile thallus of *Marchantia*, giving to the hepatic a grey-blue metallic appearance. Two fungi had invaded the hepatic, and one of these was diagnosed as a *Pythium* with sporocysts and oospores. The starch of the cells had been digested by the fungus, and the cell-walls were coloured a violet-brown. The author considers that the *Pythium* might represent a new species, *P. Marchantiae*, on account of its small oospores, or possibly might belong to a race of *P. de Baryanum* peculiar to *Marchantias*. A. L. S.

Empusa Disease of Drosophila.—BESSIE GOLDSTEIN (*Mycologia*, 1927, 19, 97-109, 3 pls.). An epidemic among fruit-flies has been noted at Columbia University during the last four years. The flies attacked are the larger black fruit-fly, *Drosophila repleta*, and, to a lesser extent, the small red-eyed fruit-fly, *D. melanogaster*. The fungus is considered to be identical with the common species, *Empusa Muscæ*, though the *Drosophila* as hosts are hitherto unrecorded; cross inoculations have so far not been made. The writer has described in more detail than has yet been done the cytology of conidial formation. She found that conidia were formed by the moving upward of protoplasm and many nuclei into a sterigma, which had arisen as a bud on the tip of the conidiophore. The bud is thus caused to swell up to form a bell-shaped conidium, which is cut off from the emptied conidiophore by a cross-wall. Resting spores similar to those of *Empusa Muscæ* were also found in *Drosophila*. A general account and synoptic key to the genera of Entomophthoraceæ is given, all of them parasitic genera attacking insects; the nuclear condition is a leading character in the determination of the genera. Methods of work are fully described, and a full list of literature bearing on the subject is given. A. L. S.

Study of Dermatophytes.—KARL V. BERDE ("Über die Pathogene Fadenpolyflora in Südungarn," *Folia Crypt. Inst. Bot. Univ. Litt. reg. Hung. Franc. Joseph*, 1927, 1, 284-5). The author obtained the material for this research and statement from the University hospital. He describes his methods of diagnosis and experiment, first by microscopic study and then by inoculation, and various conclusions are drawn from his results. Most of his cultures presented no difficulties; fragments of epithelium with the skin fungus were, however, less successful than hair cultures. The dominating fungus type in the district was *Mikrosporon Audonini*. The *Mikrospora* group were first detected in Hungary, and of these *M. Audonini* was the most frequent. The occurrence of the various fungi (17 in all) is described for the several districts and contrasted with other districts. Those of Hungary must nearly correspond with the records from Bordeaux. A. L. S.

New Discomycetes.—GEORGES MALENÇON ("Quelques espèces inédites de Discomycetes," *Bull. Soc. Mycol., France*, 1927, 43, 95-106, 1 col. pl., 5 text-figs.). The species described, five in all, belong to the genera *Anthrocobia*, *Helotium*, *Leptopodia*, *Melachoria* and *Ombrophila*. They were found in various districts in France, and not only the microscopic characters are figured, but a beautiful coloured plate gives the natural appearance of the fungi, yellow, green, purple or silver-grey. A. L. S.

Cytology of *Pyronema domesticum* (Sav.), Sacc.—GEOFFREY TANDY (*Ann. Bot.*, 1927, 41, 321-5, 1 pl.). The study was made from material growing naturally on damp wall-paper and also from cultures. Interest centred on the behaviour of the nuclei of the sexual organs. Tandy found that in this species soon after the passing of the male nuclei into the female cell—a fairly protracted affair—there is a dense massing of the nuclei toward the upper region of the oogonium, and nuclei were seen to fuse in pairs. In the ascogenous hyphæ—the next stage of development—nuclei in the diploid and in the haploid condition were observed; the haploid number of chromosomes was found to be seven. The definitive nucleus of the ascus is in some cases diploid and in others tetraploid, while the nuclei of the binucleate stage are sometimes diploid and sometimes haploid, but the nuclei at the end of the third division are always haploid, showing that in the case of the diploid condition after meiosis a further reduction had taken place. The author considers that *Pyronema domesticum* is in a transition stage. Sexual fusion is occasionally omitted, thus accounting for the presence of haploid nuclei in the ascogenous hyphæ. It is concluded that sweeping generalizations as to reduction in the ascus are not justified. A. L. S.

***Ustulina vulgaris* Tul.**—C. KILLIAN ("Observations sur *Ustulina vulgaris*, Tul. cultivé en milieux artificiels," *Bull. Soc. Mycol., France*, 1927, 43, 35-40, 2 pls.). *Ustulina vulgaris*, a common ascomycetous fungus, forms dark crusts on old stumps. Killian has made a cultural study of it on various liquid and solid media. In all the cultures mycelium and conidia alone were formed, also Killian noted that in cultures on wood the fungal hyphæ travelled along the vessels and entered the cells by the pores: no destruction of the cellular wall was observed. Constantly it was seen that on gelatinous media the fungus dug out a deep pit, and the conclusion came to was that the fungus absorbed the water of the substratum, part of which it exuded from its surface. Therefore, the author concludes *Ustulina* may be regarded as hygrophilous rather than xylophagous, and its requirements in water are met by the quantity of rain absorbed by old stumps in wet seasons. In summer the fungus defends itself against drying up by forming a carbonized surface and by passing into a resting stage. A. L. S.

Study of *Macrophomina*.—S. F. ASHBY ("*Macrophomina Phaseoli* (Maubl.) comb. nov. The Pycnidial Stage of *Rhizoctonia bataticola* (Taub.) Butl." *Trans. Brit. Mycol. Soc.*, 1927, 12, 141-7, 1 text-fig.). The author has traced the accounts of this fungus through literature as belonging to the genera *Macrophoma*, *Sclerotium*, *Rhizoctonia* and *Dothiorella*. He recognizes *Macrophoma Phaseoli* as the earliest name, but transfers it to the genus *Macrophomina* Petrak, which includes pycnidial forms devoid of stroma and with long narrow elliptical hyaline spores. In the sterile condition black sclerotia are formed. The fungus is of wide distribution and causes seedling blight, stem-rot and root decay of many economic plants in tropical and subtropical countries. A. L. S.

Notes on *Phyllachora Podagrariæ*.—C. KILLIAN ("*Phyllachora Podagrariæ* (Roth.) Karst., parasite de l'*Aegopodium Podagraria* L.," *Bull. Soc. Mycol., France*, 1927, 43, 41-8, 2 pls.). An attack of the parasite *Phyllachora Podagrariæ* is manifest by the dark-coloured spotting of the host plant *Aegopodium*. On these spots are to be found minute pycnosporos at any time from May to September. Killian has made a careful study in order to follow the hibernation of the fungus; he found that germination of the pycnosporos was scanty in artificial media, the fungus hibernates in the dead leaves of the host, the mycelium

forming pads of hyphæ, the first beginnings of pycnidia. All the different stages of growth have been followed up to the stroma stage, the stroma itself remaining in the dead leaves during the winter, and in spring producing the same type of spores as are afterwards found on the living plants. A. L. S.

Cercospora Hungariæ.—ANTAL PÉNZES ("Magyarország *Cercosporái*," *Folia Crypt. Inst. Bot. Univ. litt. reg. Hung. Franc. Joseph*, 1927, 1, 287–336, 63 text-figs.). The author here resumes work on *Cercospora* in Hungary that had been partly carried out before the war. He divides the species into three sections:—*Brachycercosporæ*, *Mediocercosporæ* and *Macrocerosporæ*, and thus aims at uniting those that have most morphological resemblance; but they are listed alphabetically according to the host plant from *Cercospora Acanthi* to *C. Vitis*. He has recorded 54 such species and gives a full synonymy, with measurements of conidiophores and conidia. These are also figured—the leaf spots and the enlarged fungi. *Cercospora* is a genus of "Fungi Imperfecti" that causes spotting and disease of the leaves. The perfect stage has not been found. A. L. S.

Tropical Fusaria.—O. A. REINKING and H. W. WOLLENWEBER (*Philippine Journ. Sci.*, 1927, 32, 103–253, 6 pls., 47 text-figs.). The writers here present a careful and thorough study of *Fusaria* that occur in tropical lands. The organisms were isolated largely from bananas, the soil of banana plantations and of virgin forests. Extensive soil cultivations were made as well as cultures from air-borne spores. Methods used in isolating from the different sources are described. Some 550 pure cultures of *Fusaria* were obtained from banana lands, 48 different *Fusaria* were found, 14 were new, namely, seven species, six varieties and one form. Technical descriptions of all the cultures are given, habitat, growth characters and measurements. It was often found that one "species" merged into another, but it was also found that there were quite distinct types and these have been set apart to represent species. The species are grouped under 14 sections, with sub-sections. They were all grown on a series of different media, and the differences of growth, due to the medium, are recorded in spore sizes, septation, colour, etc. In all cases the spores are figured. A. L. S.

Fusaria of Jamaica.—C. G. HANSFORD (*Bull. Misc. Inf. Roy. Bot. Gard. Kew*, 1926, 7, 257–88). The writer embarked on this study in connection with his experimental work on the Panama disease of the banana. The specimens were isolated mostly from the soil, but also from plant specimens and from *debris*. He has drawn up descriptive lists of these *Fusaria*. In a future work he proposes to give results of inoculation experiments with them. For purposes of classification he has arranged the fungi under various sections, following the example of Wollenweber. Hansford has found that his specimens fall under 14 sections; each section is diagnosed, as are also the species belonging to the section. In some cases, as in Sect. *elegans*, he found that the various species had such a wide range of variability that they might all be regarded as one wide species. Over 300 strains were isolated and cultured in this group, and were studied in detail. Hansford discusses the theory of the bacterial origin of banana disease, but all his observations and experiments lead to the conclusion that *Fusarium cubense* is the causal agent. An account of *Hypomyces Ipomææ* is added. A. L. S.

Uredineæ in Poland.—B. SZAKIEN ("Przyczynek do znajomości rdzy Wilnieszczyny i Grodzienschczyny." Polish with French *résumé*. *Bull. Soc. Polonaise des Naturalistes "Kopernik"*, 1927, 51, 75–138.). The writer has given an account of the knowledge of rusts in the regions of Wilno and Grodno. The

different genera are taken in order according to the host plant. In all cases the spore sizes are given which in many instances, he tells us, do not conform with those published by Klebahn and Sydow. Some varieties new to science are diagnosed, the species new to Poland are noted and new hosts are recorded for other species previously known.

A. L. S.

Fungi Brigantiani.—ROGER HEINE (*Bull. Soc. Mycol., France*, 1927, 43, 59–94, 13 text-figs.). This is the second series of fungi recorded from the high valley of the Durance. It comprises 8 Ustilaginæ and 110 Uredinæ. Heine gives an account of collections previously made in the locality. Full microscopic details are given of any unusual species.

A. L. S.

Spermogonia of Rusts.—LILLIAN M. HUNTER ("Comparative Study of Spermogonia of Rusts of *Abies*," *Bot. Gaz.*, 1927, 83, 1–23, 4 pls., 2 text-figs.). The author tells us that *Abies* is attacked by a great number of heteroecious rusts, 21 such species are tabulated the aecidial form accompanied by the spermogonia of all these being present on the *Abies* tree. Material and methods are explained; 12 species of rusts were examined. In each case the material was fixed, stained, and then embedded in paraffin; longitudinal and transverse sections were cut; drawings and measurements were made and the results tabulated and compared. Among those examined, two spermogonia were amphigenous, the others hypophyllous; two were subepidermal, the others subcuticular. Sizes of the different spermogonia differed between 42–137 μ wide and 13–30 μ long in the smallest to 311–476 μ by 86–117 μ in the largest, the spermatia were catenulate; they also varied in size according to species.

A. L. S.

Smut Fungi.—SYDNEY DICKINSON ("Experiments on the Physiology and Genetics of the Smut Fungi Hyphal Fusion," *Proc. Roy. Soc.*, 1927, 101, 126–36, 1 pl., 3 text-figs.). In the present work the results following fusion of hyphæ are studied. The Smuts used in the experiment were the covered smut of oats, *Ustilago levis*, and the covered smut of barley, *Ustilago Hordei*. The methods of experiments by culture are described. Dickinson proved that after the fusion of two hyphæ of different genders a cell is formed containing two associated nuclei. No nuclear fusion occurs. The binucleate hypha gives rise to uni-nucleate hyphæ, which are of different gender, since they are produced at different ends of the fusion-hypha, different nuclei having migrated to each end.

A. L. S.

Variability in Spores of Agarics.—M. JOSSE-RAND ("Quelques exemples de variations chez des spores d'Agaricines," *Bull. Soc. Mycol., France*, 1927, 63, 142–4). The author quotes the statement that microscopic characters are more constant than macroscopic. His examination of three agarics has proved the contrary. The spores varied from the published descriptions in size, in form, or in sculpturation.

A. L. S.

Spore-wall Structure.—LESLIE C. COLEMAN ("Structure of Spore Wall in *Ganoderma*," *Bot. Gaz.*, 1927, 83, 48–60, 1 pl.). The writer looks on spore characters as valuable in diagnosis and classification more especially in Polyporaceæ. Description of spore characters in six species of *Ganoderma* have been given. Coleman considers that the epispore (a distinctive feature in *Ganoderma*) represents the primitive spore wall. It consists of hemicellulose, with possibly a gum; the endospore is composed of chitin and other compounds, it is laid down on the inner side of the epispore as a series of granules which later fuse to form a membrane. Spiny processes form on the outer surface of the membrane and project into the surrounding epispore, thus providing a skeletal support to the thin primary

spore wall. The writer considers that species of Polyporaceæ with similar spores should be united under the genus *Ganoderma*, as the spore characters indicate real relationships. Figures of the developing spores are given in the plate. A. L. S.

New Species of *Skepperia*.—ALBERT PILAT (" *Skepperia carpatica* sp. n., nouvelle espèce intéressante du genre *Skepperia* Berk. dans les Carpathes Centrales," *Bull. Soc. Mycol. France*, 1927, 43, 48–58, 1 pl.). Species of *Skepperia* have hitherto been recorded only from tropical lands. Pilat has discovered his new species at one isolated spot in the Carpathians. He publishes a history of all the species along with his new plant and gives careful microscopic details, paying especial attention to the cystidia, their form and position in the fruiting body. One species first published as *Craterellus spathularia* Berk. and Curtis, has now been placed by him in a new genus *Skepperiella*, as it is a *Skepperia* without cystidia. A. L. S.

Mycological Notes.—R. KÜHNER ("Notes mycologiques," *Bull. Soc. Mycol. France*, 1927, 43, 107–16, 4 text-figs.). Descriptions are given of some minute Agarics with special reference to microscopic characters especially the cystidia. Two new species of *Androsaceus*, very minute forms, are included in this survey.

A. L. S.

***Tricholoma pseudoacerbum*.**—COSTANTIN and DUFOUR ("Note sur le *Tricholoma pseudoacerbum*," *Cost. et Duf., Tom. cit.* 117–8.) The authors again describe the particular characters that distinguish this *Tricholoma*, its autonomy having been called in question by other workers who failed to note the salient points of difference. The Agaric is chiefly recognized by its dwarfed aspect, the length of the stipe being only half or one-third the diameter of the head, but other characters bear out the authors' claim for the recognition of new species.

A. L. S.

Host Plants of *Fomes annosus*.—MALCOLM WILSON (*Trans. Brit. Mycol. Soc.*, 1927, 12, 147–149). *Fomes annosus* causes Red Rot or Heart Rot in this and other countries of Western Europe. It occurs mainly on conifers. It has been recorded in North America on pines, but is of rare occurrence. American pines introduced into this country, however, are frequently victims of the European strain of the fungus. Malcolm records also many instances of its parasitism on dicotyledonous trees of many kinds, though whether they are attacked by a different strain of the fungus has not yet been established.

A. L. S.

New or Noteworthy Basidiomycetes.—W. C. COKER (*Journ. Elisha Mitchell Sci. Soc.*, 1927, 42, 251–7, 3 pls.). Coker describes in this paper *Clavaria Stillingeri* n.sp., a small plant with branching fruit bodies up to 2 cm. high; it was found at Idaho; *Lachnocladium pusillum* n.sp. which grew in Holland on a pot containing *Rhamnus*, in a hot house, also a small plant and interesting as being the second collection of *Lachnocladium* in Europe. Several plants belonging to the Gasteromycetes are also recorded. An abundant growth of *Arachnion album* Schw. led to a study of the fungus and to the formation by Coker and Couch of a new family, Arachniaceæ, differing from Lycoperdaceæ in the single peridium and absence of capillitium.

A. L. S.

New or Little-Known Fungi.—E. BAUDYS ET R. PICBAUER ("Fungi novi vel Mixus Cogniti II," *Acta Soc. Sci. Nat. Meravia Bruno, Czechoslovakia*, 1925, 2, 155–61, 3 text-figs.). The authors give the diagnoses in Latin of a number of new species or varieties (Ascomycetes and Fungi Imperfecti) which grow on living or dead plants. The habitats on host plants are indicated.

A. L. S.

N. Patouillard (1854–1926), Obituary Notice.—L. MANGIN (*Bull. Soc. Mycol., France*, 1927, 43, 8–23). Patouillard, whose death has been widely lamented, gave great attention to the microscopic characters of fungi, and on these he founded new systems of classification which have proved of great service to students of mycology, especially of the Basidiomycetes. A list is given of his contributions to mycology dealing with fungi from every quarter of the globe; two papers alone deal with Phanerogams. The works cited number 241, the last was published after his death in 1927. (See below.)
A. L. S.

Fungi from Annam.—N. PATOULLARD ("Travaux posthumes de N. Patouillard. II, Champignons nouveaux de l'Annam," *Tom. cit.*, 24–36). The paper contains descriptions of new fungi collected by M. Poilare in the mountain forests of Annam. These are nearly all Basidiomycetes, and detailed descriptions supplement the scientific diagnoses. There are 14 Basidiomycetes and two Ascomycetes included in this posthumous paper.
A. L. S.

Parasitic Fungi.—R. TEHON and E. Y. DANIELS ("Notes on the Parasitic Fungi of Illinois"—III, *Mycologia*, 1927, 19, 110–29, 1 pl.). The fungi here described consist of incidental collections of the Illinois State Natural History Survey's botanists. Five Ascomycetes and 29 Fungi Imperfecti, all new to science, are described by the authors. Two new genera of Ascomycetes are included, *Rostrosphæria* (Gnomoniaceæ) and *Exilispora* (Sphæriaceæ), the latter with a rostrate osteole and dark-coloured scoleciform spores.
A. L. S.

Oregon Fungi.—S. M. ZELLER ("Contribution to Our Knowledge of Oregon Fungi—II, Mycological Notes for 1925," *Mycologia*, 1927, 130–43, 5 text-figs.). The species listed belong to a series of Phycomycetes and Ascomycetes. Several new species are described. One of these, *Exoascus Pruni-subcordata*, grew on immature fruits of the Sierra plum, and is very common and destructive. "Seemingly it does not infect cultivated varieties of *Prunus* growing nearby the infected wild host."
A. L. S.

Congo Fungi.—M. BEELI ("Contribution à l'étude de la flore mycologique du Congo II and III," *Bull. Soc. Roy. Belgique*, 1927, 59, 101–112, and 160–3, 2 pls.). The fungi described in these papers were collected by Madame Goossens in the districts of Lake Leopold II of the Equator and of Bangala; they are accompanied by coloured plates representing the fungus in the fresh condition. The two plates published give an outline sketch of the species (new with two exceptions), which belong to *Amanita* or to *Lepiota*, except *Armillaria dactylophora* (Lév.). Beeli notes that *Lepiota procera* is eaten by the natives, and he records three names given to it by them. In other instances native names are given to species that are striking in appearance but are not described as edible. In the second paper two mycetozoa are listed, *Fuligo septica* and *Stemonitis splendens*; also several Ascomycetes and a number of Basidiomycetes mostly new to science.
A. L. S.

African Fungi.—M. M. DUKE ("Fungi from Kenya Colony," *Bull. Misc. Inf. Roy. Gard. Kew* 1926, n. 8, 305–20). The paper is one of a series dealing with the Fungi of British Colonies. Notes are given on climate, elevation, etc.; although lying across the equator, Kenya is a highland region and affords temperate conditions in which European and even British fungi flourish. The fungi are frequently associated with the crops (potatoes, fruit, vegetables, etc.), and may be, and often are, pathological. Two fungi causing coffee disease are listed, as well as others on trunks such as *Fomes juniperinus*, a serious disease of forest trees, and

others on leaves causing spots, etc. One new species *Sphacelotheca Themedæ* is described. It grew in the ovaries of *Themeda triandra* at Nairobi. A fairly large number of rusts have also been determined by Miss Duke. A. L. S.

Studies in Entomogenous Fungi.—XIII. Glenospora.—T. PETCH (*Trans. Brit. Mycol. Soc.*, 1927, 12, 105–13). Petch has made an exhaustive study of this puzzling genus, both of the literature and of the herbarium specimens. *Glenospora* was instituted and described by Berkeley and Desmazières in 1869, and again described by Berkeley as *Glenospora* B. and Curt. in 1876. The diagnoses do not quite agree. All the species and the descriptions are subjected by Petch to careful analysis. Finally he decides that the genus necessarily dates back to the first publication in 1849, and that *Glenospora* is probably identical with *Septobasidium*. A. L. S.

Poisoning by Fungi.—E. MARTIN-SANS ("Les empoisonnements fungiques dans le Sud-Ouest en 1926," *Bull. Soc. Mycol. France*, 1927, 43, 122–31). Martin-Sans indicates the two seasons of fungus-growth—spring and autumn—these being periodically followed by cases of poisoning. A large number of instances of illness due to eating various fungi are chronicled by the author—in several cases the attack causing death. In most cases the deadly fungus was *Amanita phalloides*, but *Clitocybe dealbata* was the toxic agent in one case. Martin-Sans also directs attention to the danger of dried fungi; not that the fungi are poisonous, but that they are often badly preserved and become unfit for food. In the Pyrenean districts, he states, cases of poisoning are frequent, but in 1926 *Boletus edulis* was so abundant that the peasants ate no other and so escaped all danger. A. L. S.

Ecology of Fungi in the Chicago Region.—V. O. GRAHAM (*Bot. Gaz.*, 1927, 83, 267–87, 6 text-figs.). The writer comments on the very diversified features of the area with which he is dealing—the moraine deposit, the dune area, and the adjoining swamps, the outcropping of Niagara limestone, the rivers and Lake Michigan, physiographic features which are accompanied by plant associations of great variety. In two of the text figures Graham has sketched the outstanding characteristics of Basidiomycetes, the fungi of most prominence in field work. The third figure represents a "young bog association" in which eight fungi, mostly Agarics are represented. The growth of the fungi is largely seasonal, and the author has depicted both spring and autumn communities. There is also a section devoted to soils and the amount of humus present in certain areas. On rocks the most important fungi, he tells us, are lichens—other fungi on rocks are related to the accumulation of humus rather than to the underlying rock. A. L. S.

Red Colouration in Boleti and in Russulas.—P. BREBINAUD ("Bolets à pores rouges et russules rouges," *Bull. Soc. Mycol. France*, 1927, 43, 132–41). The author picks out three principal types of the red-pored Boleti—*B. luridus*, *B. erythropus*, and *B. satanas*. He finds that the red colour is not constant, that yellow is the basic colour, and that occasionally some pores are red, while others are yellow; also that the red colour extends to the flesh of the fungus. He finds, further, that macroscopic characters in these Boleti—such as colouration, size and form—are unstable, the microscopic characters being more reliable. Notes are given on the red Russulas; these have a basic white colour, and may revert to whiteness or never develop to redness. Finally, detailed diagnoses are given of the three Boleti mentioned above. A. L. S.

Action of Fungi on Cellulose.—R. D. REGE ("Bio-Chemical Decomposition of Cellulosic Materials, with Special Reference to the Action of Fungi," *Ann. Appl. Biology*, 1927, 14, 1-44, 4 pls., 7 graphs and 1 text-fig.). In recent years a great deal of work has been done on the part played by fungi in cellulose decomposition in the soil, etc. The problem is bound up with that of the chemical constituents of organic materials, as well with the activities of the destroying organisms. Experiments were made with rice-straw—susceptible to decomposition—and poplar wood, a resistant material. It was found that an important condition for rapid decomposition was the predominance of pentosans or lignin in the material—the former is described as the food of micro-organisms or *energy factor*, the other the lignin, is the *inhibitory factor*. It was proved that fungi played a more prominent part than bacteria in the early stages of decomposition; at later stages the fungi are decomposed by other organisms. The ability of certain fungi to grow at high temperatures and to produce the necessary enzymes further confirmed their importance in decomposition. Their activity in manure heaps is strongly suggested
A. L. S.

Brown-rot Fungi.—H. WORMALD ("Further Studies of the Brown-rot Fungi; II. A Contribution to our Knowledge of the Distribution of the Species of *Sclerotinia* causing Brown-rot," *Ann. Bot.*, 1927, 41, 287-99). The above paper deals with two species of fungi, *Sclerotinia fructigena* and *S. cinerea*, which cause brown-rot diseases of fruit trees. A comparison is made with similar diseases from other countries. Specimens have been sent to the author who writes from his own observations, and also includes the results arrived at by other workers. In all cases the disease causes extensive economic loss. The results of his study as to occurrence are as follows:—*Sclerotinia fructigena*: Europe, Japan, Manchuria, but absent from the great fruit-exporting regions of North America, Australia and New Zealand. *Sclerotinia cinerea* f. *Pruni*: Europe, Pacific coast of North America, Manchuria, and possibly Japan; form *mali*: Great Britain and Ireland and probably the Continent. *Sclerotinia americana*: The United States, British North America, Australia and New Zealand. It is unknown in Europe with a single exception discovered in Holland. It is very destructive in its native countries, and its introduction in Europe should be carefully guarded against.
A. L. S.

Mycology and Plant Pathology.—GEORGE H. PETHYBRIDGE (Presidential Address, *Trans. Brit. Mycol. Soc.*, 1927, 12, 91-105). The author marks the stage of progress reached in the activities of the members of the Mycological Society as to the knowledge of fungi in the British Isles. He suggests further aims of study in the examination of the ecological conditions and still more in inquiring into the causes of disease due to fungi and into the physical conditions that induce or deter the attacks of fungi. He traces the history of our knowledge of parasitic fungal plant diseases in this country, and gives a sketch of the various institutions and societies that are dealing with these problems so important to the welfare of the nation. The necessity for the more intensive training of plant pathologists who can undertake and carry on research work of all kinds is also emphasised.
A. L. S.

Conifer Disease.—MALCOLM WILSON ("The *Phomopsis* Disease of Conifers," *Forestry Commission, Bull.* n. 6, 1925, 1-34, 12 pls.). The Douglas fir has been considered to be a tree remarkably free from disease. Recently, in this country, it has suffered badly from the attacks of *Phomopsis Pseudotsugæ*. The young shoots are attacked and killed back from some distance. Wilson has made a prolonged study of the *Phomopsis* fungus in all its phases, and in its effect on the

host trees. He has examined the disease as it occurs on Douglas fir, on Blue Douglas fir, Japanese larch, European larch, and on species of *Abies*. The attack of the fungus on the leading shoots very seriously retards growth, and in many cases injures the timber even though in time all external trace of the canker may have disappeared. The disease is most dangerous to young plants, and the nurseries should be carefully watched; any diseased plants should be removed and burnt, and all wounding of healthy plants should be avoided so as to lessen the chances of infection.

A. L. S.

Fungal Parasites in Belgium.—É. MARCHAL and G. VERPLANCKE ("Champignons parasites nouveaux pour la flore belge observés de 1919 à 1925," *Bull. Soc. Roy. Bot. Belgique*, 1926, 59, 19-26, 1 pl.). The paper is a continuation of one previously published in 1922 in the same journal. The species recorded belong to nearly all classes of fungi. Notes are given as to the disease caused by particular attacks, as, for instance, the depredation caused by *Pseudoperonospora Humuli* on hops. Six new species are described. One of these, *Phoma Lini*, had been noted by Pethybridge in Ireland without any precise description; it rots the base of the stem and quickly kills off the young flax plants. The new species are figured on the plate.

A. L. S.

Shot-hole Leaf Disease.—GEOFFREY SAMUEL ("On the Shot-hole Disease caused by *Clasterosporium carpophilum*, and on the 'Shot-hole' Effect," *Ann. Bot.*, 1927, 41, 374-404, 18 text-figs., 2 pls.). The paper deals with a disease of leaves of the almond (*Prunus Amygdalus*). It occurred in Australia, and the research was carried out at Adelaide; but it has also been recorded in Algeria and in America. The fungus has been classified under eight different names, but the author concludes that it should be called *Clasterosporium carpophilum*. He gives reasons for the decision. The germination of the spores, and their penetration of the cuticle and the cellulose walls, are described. The host cells die in advance of the fungus-hyphae. The reaction of the leaf tissues is also followed: a liquefaction of cells occurs, and there follows a splitting and a dropping out of the diseased tissue. This occurrence is influenced by the amount of moisture present.

A. L. S.

Seedling Diseases of Beets.—G. H. COONS and DEWEY STEWART ("Prevention of Seedling Diseases of Sugar Beets," *Phytopathology*, 1927, 17, 259-96, 9 text-figs., 12 pls.). The paper is an inquiry into the root diseases of sugar beets, which, in the form of damping off and other kinds of root disease, cause enormous loss in all districts. There are two sources of trouble—infection of the seed and the presence of the fungus in the soil. Results of experiments have shown that *Phoma Betae*, *Pythium* spp. and *Rhizoctonia*, sp. all give rise to diseases which vary in the type of attack. Experiments were made in the sterilizing of the seed, by soaking it in copper carbonate or other sterilizing media, and by the dry method, that is, shaking up the seed for a few minutes in a container with a mixture of copper-sulphate-lime dust. The various growth experiments are carefully described, and the results obtained. Wet treatments, it was found, were "impractical for commercial use, because of the difficulty inherent in drying the seed in quantity." Pasteurization of the soil at 60° failed to give protection against the infested soil. Treating the seeds with mercury and copper compounds not only reduced the diseases from seed source but also protected against soil fungi.

A. L. S.

Root-rot Fungi.—W. BUDDIN and E. M. WAKEFIELD ("Studies on *Rhizoctonia crocorum* (Pers.) Dl., and *Helicobasidium purpureum* (Tul.) Pat.," *Trans. Brit. Mycol. Soc.*, 1927, 12, 116-40, 4 pls.). The research by two workers is based

on a specimen of black currants which had a dense felted violet growth round the main stem, and which was identified as *Helicobasidium purpureum*. Subsequently it was found that the roots bore evidence of the presence of *Rhizoctonia crocorum*, a root parasite of many plants. Tests were made by field observations and by laboratory cultures and inoculations to find the connection, if any, between these two fungi. In the field new instances were found of the associated fungi on red clover, and in another locality on *Mercurialis perennis*, in still another locality on *Urtica*. A full description of growth and development is given and contrasted of the two types of fungi. Laboratory cultures were made of the different mycelia as well as inoculation experiments, and ample proof has been found of the close association of these two parasites: "the balance of the evidence favours the view that *Helicobasidium purpureum* is the perfect stage of *Rhizoctonia crocorum*."

A. L. S.

Parasitic and Saprophytic Fungi.—RAFAEL CIFERRI and ROMUALDO GONZÁLEZ FRAGOSO ("Hongo parásitos y saprofitos de la Republica Dominicana," *Bol. Real Soc. Esp. Hist. Nat.*, 1926, **26**, 491–9, 9 figs.). This is the eighth series of papers on these fungi. The first record is of a mycetozoon *Arcyria cinerea* var. *digitala* which is new to the Dominican flora. Most of the records are of micro-fungi, a large majority of which are new and parasitic. The illustrations, as in previous papers, have been drawn by Luisa de la Vega from laboratory preparations.

A. L. S.

Toxicity of Dust Fungicides.—H. ATHERTON LEE and J. P. MARTIN ("A Method for Testing in Vitro the Toxicity of Dust Fungicides to Fungus Spores," *Phytopathology*, 1927, **17**, 315–19, 2 tabs.). The tests were made in the laboratory with the germinating spores of *Helminthosporium Sacchari* which causes eye-spot leaf disease of sugar-cane. The spores were suspended in a drop of sterile water, a fungicidal dust was blown on to the drop and the results watched. Various kinds of dust were used. Most of them were effective.

A. L. S.

Lichens.

Lichens in South-Eastern Sicily.—GIACOMO ALBO ("La vita della piante nella Sicilia Meridionale-Orientale," *Parte III, Licheni*, Palermo, 1926, 1–87). In this study Albo divides his subject into a number of sections beginning with the economic use of lichens, as employed for food, for medicine, and for dyeing, etc. He then passes on to the biology of these plants: their acid production and their wide distribution due to their symbiotic structure. The physiology of lichens is next touched on—their respiration and assimilation, with the influence of temperature on these functions, though lichens, above all other plants, can resist extremes of either heat or cold. The formation of carbo-hydrates by the alga is discussed, and the origin of the mineral contents of the plants. Special stress is laid on the importance of the gelatinous substance—a constant feature in lichen substances. It retains water and it also retains the mineral particles from the air or from water. Oxalic acid, which is constantly present, lowers the freezing point of the lichen sap, which may then remain in liquid form below zero. An account of lichens found in the district follows.

A. L. S.

Further Study of Stereocladium.—E. BACHMANN ("Nochmals Stereocladium tirolense Nyl.," *Hedwigia*, 1927, **67**, 99–109, 7 text-figs.). This lichen was determined by Bachmann in a previous study to be a species of *Stereocaulon*—*St. tirolense*. The discovery of new localities and of new specimens has led to the formation of a new species *St. saxonicum*. Bachmann has given a detailed

anatomical study of thallus and fruit production and his reasons for considering that the plant from Saxony is worthy of specific rank. A. L. S.

Lichens of Asia Minor.—ÖDÖN SZATALA ("Lichenes in Asia minore ab direttore D^{re}. Stefano Györfy de Szeged et D^{re}. Josefo Andrasovsky collecti," *Folia Crypt. Inst. Bot. Univ. litt. reg. Hung. Franc.-Joseph*, 1927, 1, No. 5, 272-7.) A fairly long list of lichens from a region that has been little explored for these plants. There are no new species, and most of the lichens are members of the European, or even of the British, flora. A. L. S.

Lichenes Hungariae.—ÖDÖN SZATALA ("Magyarország Zúzmóflórája, I. Pyrenocarpineæ—Gymnocarpineæ (Coniocarpineæ)," *Tom. cit.*, 337-434). The author has worked through vast collections of lichens principally those of Lojka and Hazslinsky, and has given us here the first instalment of a complete lichen flora. No descriptions are given, but there is a useful synonymy and localities are cited from eight different divisions. A list of 120 papers or books dealing with Hungarian lichens is given: the country is rich in lichens and has been well explored. Most of the families and genera dealt with, so far, are crustaceous, microscopic species. A. L. S.

Study of Verrucariæ.—HERMANN ZSCHACKE ("Die Mitteleuropäischen Verrucariaceen, V, 4, Verrucaria," *Hedwigia*, 1927, 67, 45-85). The study deals with freshwater forms of *Verrucaria*; these include those that grow in or near streams or in specially moist localities. Special attention is given to the algal symbiont, of which there are two types which the author designates as (1) *Pleurococcus* algæ, with a thickish wall mostly one-celled though sometimes two or more celled, present in very few species, and (2) *Coccomyxoid*, sometimes elongate, sometimes globose, always one-celled and with a thin wall. He does not place the algæ in genera. Zschacke has described 45 of these more or less aquatic *Verrucariæ* for Mid-Europe. A synoptic key is given of the species, primarily based on the perithecium—whether entire or dimidiate—then the type of perithecial wall and of thallus. Another point of difference is the relation of the thallus to the perithecium: whether it remains at the base with the fruit-body emergent, or whether the thallus grows up around and almost over the perithecium, its presence indicated by the gonidia which intrude almost to the opening of the perithecium. A. L. S.

Acarosporæ.—A. H. MAGNUSSON ("Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya, 1921, N. 34," Oslo, 1926, 7 pp.). Magnusson records 10 species of *Acarospora* from Nova Zembla, among them two new species and a new variety, *A. bullata* var. *arctica*. Full descriptions are given of the new plants. A. L. S.

Swedish Lichens.—A. H. MAGNUSSON ("New or Interesting Swedish Lichens, IV," *Botaniska Notiser*, 1927, 115-27). The author fully describes 8 lichens, 2 of them new to science. One of these, *Ochrolechia bahusiensis*, on oak bark, has a diffuse sorediose thallus; the other, *Lecanora rimicola*, on granite rocks near the sea, is a minute species near to *Lecanora Hageni*. A. L. S.

Epiphyllous Lichens.—E. FREY ("Epiphylle Flechten," *Mitteil. Naturforsch. Gesellsch. Bern*, 1923, 1-2). The author contrasts the abundance of tropical epiphyllous lichens on the thick-leaved evergreen trees with the scarcity of such leaves and lichens in temperate lands. Pine needles, however, are frequently overgrown with *Parmelia physodes* in European countries, and a number of species

grow on the leaves of *Buxus sempervirens*. As a rule, they spread from the branches on to the leaves. A growth of *Physcia tenella* that had developed from soredia is described: it adhered closely to the leaf without damaging it, and in two years had reached a diameter of 1 cm.

A. L. S.

Russian Lichens.—M. P. TOMIN ("Neue Flechten aus Süd-Ost-Russland." Russian with German translation. Woronesh, 1926, pp. 1-8). The lichens were collected in the Gouvern, Astrachan. Five species are described, of which four are new to science: they grow on soil or rocks.

A. L. S.

Lichens from Woronesh.—M. P. TOMIN ("Beiträge zur Lichenen-Flora des Gouvernements Woronesh," pp. 1-14 (undated). Russian, with a short German résumé and a Latin diagnosis of a new species *Dermatocarpon subcinereum*. Tomin lists 141 species, and gives the names of the various collectors.

A. L. S.

Lichens of Finland.—E. A. VAINIO ("Lichenographia Fennica III, Coniocarpeæ," *Acta Soc. Fauna et Flora Fennica*, 1927, 57, No. 1, 1-138). The present contribution to a large work on northern lichens is concerned wholly with the puzzling group of Coniocarpeæ. In some of them the thallus—with hyphæ and gonidia well marked—is constant and easily recognized; in others the thallus, as far as gonidia are concerned, is more or less non-existent. The group is so well-marked and so closely related as regards the fruit development that genera and species have been handed about between fungi and lichens. According to personal views, Vainio has included all of them in this work; but has separated those that lack gonidia into genera of fungi, several of them new creations, though all are included in this Lichen Flora. There are three families or "tribes," Sphærophoreæ and Tholurneæ in which the lichen thallus admits of no dispute, and a third tribe, Calicieæ, in some members of which the thallus is absent or doubtful. Vainio describes in the latter tribe 16 genera. From the lichen genus *Calicium* he has withdrawn two species and formed a new genus *Caliciella*, distinguished as "belonging to fungi." He has also included a fungus genus *Embolidium* Sacc., some species of which have been recorded as lichens. Another new genus *Strongylopsis* is also based on lichen species, now placed among fungi. The next, a lichen genus new to science, *Chaenothecopsis*, is distinguished by spore characters. Three genera, *Strongleuma*, *Coniocybopsis*, *Microcalicium*, are new to science, and along with *Mycocalicium*, are described as "belonging to fungi." Finally, *Roesleria* is included, though "belonging to fungi" and usually included in Fungus Floras. But all those genera and species are characterized by the retention of the spores in the fruit body after maturity, thus forming a powdery mazædium, and doubtless Vainio's object has been to give a connected account of all of them. Research in old herbaria has resulted in the substitution of old names that are "new" to present-day workers. The synonymy is complete and descriptions are extensive.

A. L. S.

Mycetozoa.

Hungarian Mycetozoa.—G. VON MOESZ ("Fungi Hungariæ I, Myxomycetes," *Folia Cryptogamia, Inst. Bot. Univ. litter. reg. Hung. Francoisco-Josephinæ*, 1926, 1, 111-83 and 185-98, 1 text-fig.). The latter citation, pp. 185-98, presents a German résumé of Moesz's long work. The author has used all possible sources of information in order to make his work complete. He has compared specimens from old herbaria, and has brought his list up to date. It amounts to 101 species with 11 varieties; and localities number 583. He himself has seen specimens from 377 places. One new species, *Licea hungarica*, is described and figured.

A. L. S.

NOTICES OF NEW BOOKS.

Les Microbes.—By P. G. Charpentier. 1927. 77 pp., 59 plates. Published by Les Editions Rieder, 7, Place Saint-Sulpice, Paris. Price Fr. 16.50.

Lepidoptera Rhopalocera.—Catalogue of the Type Specimens in The British Museum. Part III, Nymphalidæ. By A. G. Gabriel. 1927. 128 pp. Published by The British Museum (Natural History), London, S.W. 7. Price 7s. 6d.

Index Animalium.—By Carolo Davies Sherborn. Part XII. pp. 2881–3136. 1927. Published by The British Museum (Natural History), London, S.W. 7. Price 10s.

Principles of Soil Microbiology.—By S. A. Waksman. 1927. xxviii. 897 pp., 19 plates, 77 text-figs. Published by Baillière, Tindall & Cox, 8, Henrietta Street, London, W.C. 2. Price 45s.

The Bembridge Flora. Vol. 1. A catalogue of the Cainozoic Plants in the Department of Geology, British Museum (Natural History), by E. M. Reid and M. E. Chandler: with a section on the Charophytæ by J. Groves. 12 plates and numerous text-figs. and diagrams. Published by the British Museum (Natural History), London, S.W. 7.

The material from which this catalogue has been formed was collected after the middle of the Nineteenth Century by James Edwin Ely A'Court Smith (1814–1900). The Trustees of the British Museum have commissioned Mrs. Reid and Miss Chandler to form this catalogue. Their knowledge and skill in this department of botany are unequalled, and the result of their labours is the outcome of prolonged devotion to a branch of scientific work of the very greatest interest. An introduction of 32 pages deals with the history and nature of the A'Court Smith Collection, analyses of the flora relative to habitat and character and its relation to other fossil flora. There is a table showing the distribution of living allies of the fossil species in Europe, Africa, Asia, Australia and America. This is one of the most interesting parts of the catalogue, and gives a good idea of the immense amount of care taken by the authors in examining growing and dried specimens at Kew and other gardens and museums. The introduction is followed by a detailed systematic description of all the species of fossil Bembridge plants. It is most interesting to the botanist to realize that many of these fossil plants are so nearly identical with plants now growing in Europe, the Continent, and in the East, and with many which are now found growing in our own gardens. At the end of the volume there is a series of 12 plates of very beautiful reproductions of photographs taken by the authors of leaf impressions, fruits and seeds. One's only regret is that so many of these are crowded together in the plates; they are so beautiful that they deserve a much more liberal spacing. Taken as a whole, the work is a unique treatise rather than a catalogue and is the result of years spent in most patient and zealous microscopical work at home, and investigation and study at Kew and elsewhere. Great praise is due to the keeper of the Geological Department of the British Museum and to his assistant for the manner in which the volume has been produced.

P. T. B. B.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, JUNE 1ST, 1927, DR. JAMES A MURRAY, M.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of Messrs. Watson Kirkconnell, M.A., and John A. Long.

New Fellows.—The following was elected an Ordinary Fellow of the Society :—

Everard Arnold Mills.

A donation was reported from :—

Adlard and Son, Ltd.

“Segregation and Autogamy in Bacteria.”

A vote of thanks was accorded to the donors.

Death :—

Mr. A. D. Michael. Elected 1877.

A vote of condolence with the relatives was passed.

THE ANNUAL POND-LIFE AND GENERAL MICROSCOPICAL EXHIBITION.

The following objects were exhibited by Fellows of the Society and Members of the Quekett Microscopical Club :—

Mr. F. Addey, F.R.M.S.	.. ..	<i>Pinus sylvestris</i> , transverse section of leaf.
Mr. S. C. Akehurst, F.R.M.S.	.. ..	May-fly (<i>Gloëon</i> , sp.).
Mr. S. E. Atwell, F.R.M.S.	.. ..	<i>Corixa fossarum</i> , ova and larva.
Mr. W. E. Watson Baker, F.R.M.S.	.. ..	<i>Lophopus crystallinus</i> .
Dr. E. W. Bowell, F.R.M.S.	.. ..	Stereo-photograph of Fly.

Mr. A. J. Bowtell, F.R.M.S.	..	Diatoms.
Mr. T. G. Brooker, F.R.M.S.	..	<i>Batrachospermum moniliforme</i> .
Mr. M. T. Denne, O.B.E., F.R.M.S.	..	<i>Mymar pulchellus</i> .
Mr. F. B. Gibbard	..	<i>Hydryphantes dispar</i> .
Mr. L. G. Gilpin-Brown, F.R.M.S.	..	Brain section of Blow-Fly.
Prof. J. P. Hill, F.R.S.	..	Stained preparations of Polyzoa.
Mr. J. T. Holder, F.R.M.S.	..	Larva of <i>Corethra plumicornis</i> .
Mr. A. Morley Jones	..	Diatoms in gelatinous tube (<i>Schizone- nema</i> , sp.), also <i>Floscularia</i> , sp.
Mr. H. J. Lawrence	..	<i>Ilyocryptus sordidus</i> .
Dr. R. J. Ludford, F.R.M.S.	..	Vaccinia virus inclusions in Birds and Mammals.
Mr. E. R. Martin	..	Various Water-Mites.
Dr. J. A. Murray, F.R.S., P.R.M.S.	..	<i>Cristatella mucedo</i>
Mr. C. A. Newton, F.R.M.S.	..	Diatoms.
Mr. C. H. Oakden, F.R.M.S.	..	Water-Mite (<i>Acerous ornatus</i>).
Mr. J. M. Offord, F.R.M.S.	..	<i>Ophrydium versatile</i> .
Mr. J. Richardson, F.R.M.S.	..	Tadpole of Newt.
Dr. F. W. Rogers Brambell, F.R.M.S., and Dr. A. S. Parkes, F.R.M.S.	..	Experimental Studies on the Gonads of Mice.
Mr. R. S. W. Sears, F.R.M.S.	..	<i>Oscillatoria</i> , sp., also <i>Zoethamnium</i> .
Mr. A. E. Smith	..	Tadpole of Newt.
Dr. C. Tierney, F.R.M.S.	..	<i>Amoeba proteus</i> .
Mr. W. R. Traviss	..	<i>Dileptus</i> , sp., also Green <i>Vorticella</i> .
Mr. J. Wilson, F.R.M.S.	..	Various species of <i>Closterium</i> , also <i>Diffugia</i> , sp., and <i>Volvox globator</i> .

At the invitation of the President Mr. D. J. Scourfield described the pond-life exhibits and said that in consequence of the generally prevailing bad weather collecting had been rendered somewhat difficult and there was some paucity of available living material on exhibition. He drew attention to certain representative species of the various groups, and emphasized the value and importance of these microscopic forms as objects of critical biological study.

Dr. R. J. Ludford then described the General Exhibits, and drew special attention to a series of stained preparation of Polyzoa exhibited by Professor J. P. Hill, and also to some experimental studies on the gonads of mice which, at the request of the President, were further briefly described by Dr. A. S. Parkes.

On the motion of the President, a hearty vote of thanks was accorded to the Members of the Quekett Microscopical Club—to the Fellows of the Royal Microscopical Society, who had contributed to the success of the evening by bringing exhibits, and to Mr. Scourfield, Dr. Ludford, and Dr. Parkes for their remarks, and to Messrs. Ogilvy and Co. for the loan of microscopes and lamps.

The business proceedings then terminated and the meeting adjourned for the Summer Vacation.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1927.

TRANSACTIONS OF THE SOCIETY.

XVII.—AN AERATING AND CIRCULATING APPARATUS FOR
AQUARIA AND GENERAL USE.

H. GRAHAM CANNON, Professor of Zoology, Sheffield University, and
A. J. GROVE, M.A., D.Sc., Lecturer in Zoology, Sheffield University.

(Read October 19, 1927.)

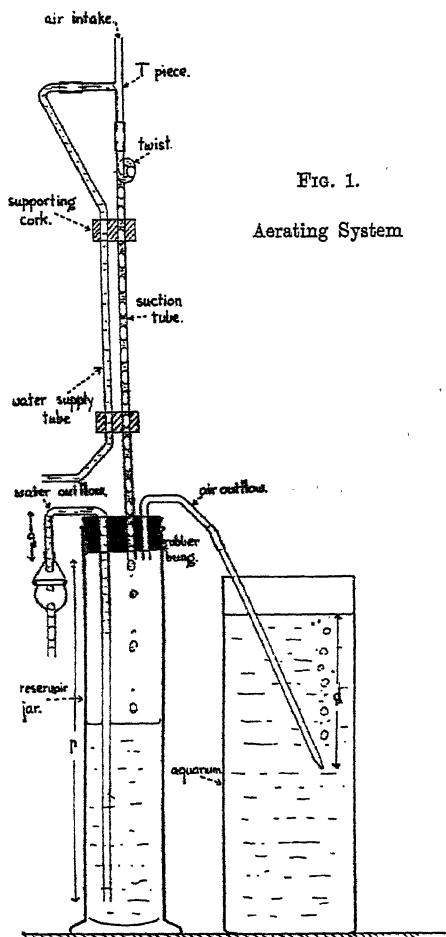
TWO TEXT-FIGURES.

IN establishing marine aquaria in the Zoology Department of Sheffield University, we have devised a form of air pump and circulating apparatus, a description of which we think may be of use to anyone who wishes to set up an aquarium for the cultivation of microscopic organisms. Both pump and circulator are simplified forms of apparatus that has already been described.

Fig. 1 is a diagrammatic view of the pump, drawn roughly to scale, and is self-explanatory. The water-supply tube is connected to any convenient water-supply. A water main is not necessary; an ordinary reservoir which can be filled periodically will answer the purpose. The water enters the horizontal arm of the glass T-piece and falls down the vertical arm into the suction tube. This is provided near the top with a complete twist. It is an advantage for this twist to be badly made. A twist in the form of a perfect circle does not work nearly so well as one containing one or two constricted bends such as the ordinary amateur glass-worker manages to produce. The water in passing through the twist sucks in air from the upper vertical arm of the T-piece, which is open to the air. A mixture of

air and water thus passes down the suction tube into the reservoir jar. The water accumulates at the bottom and then passes out by the water outflow pipe. The air is forced out from the top of the jar through the air outflow.

The mechanics of the apparatus are fairly simple. It is obvious that if air is to escape from the outflow pipe the pressure inside the reservoir jar must be at least greater than that due to a column of water of height d ,



the depth of the nozzle of the air outflow below the surface of the water to be aerated. This pressure is provided by the weight of the falling column of air and water in the suction tube. This pressure not only forces air out, but also pumps the water out of the water outflow tube, and it is clear that the difference in level between the water in the reservoir jar and the opening of the outflow pipe will also be equal to the depth d .

The depth of the nozzle of the air outflow tube below the surface of the

water to be aerated thus controls the pressure inside the reservoir jar. In the apparatus figured, the limiting depth at which aeration could be carried out is thus equal to the depth p . If this depth were exceeded, air would be forced out of the water outflow. The minimum depth for possible aeration is q . On commencing to use the apparatus the water outflow tube is empty. Directly the water-supply is turned on, water passes up the water outflow tube to a height above the water in the reservoir jar, depending on the depth of the air nozzle below the water. If the height is less than q , it is clear that water would be forced out of the air outflow before it commenced passing out of the water outflow. This is of great importance when marine aquaria are being aerated.

The outflow tube for the water must have an air break as near the top of the reservoir jar as possible. If the tube is carried down the outside of the jar to the bottom, it siphons the water out directly it fills, while if it is carried any distance towards the bottom, it narrows the pressure limits through which the pump will work.

The functioning of the pump is independent of the pressure of the water-supply, and this is one of its most important features. All water-supplies vary in pressure during the day and night, and most pumps have to be adjusted to one particular pressure. The pump we have devised always works at a pressure determined by the depth of the air outflow below the water, and thus alterations in the pressure of the water-supply simply alter the rate at which the air is pumped out. The pump never stops working unless the water-supply is completely out off.

The figure we have given shows the principle of the pump and illustrates the form we have found most convenient, but it is clear that it can be modified to suit other conditions. For instance, if a tank of water is used as the supply, the uptake water tube can be discarded and the water led directly into the horizontal arm of the T-piece. Also the height of the reservoir jar and suction tube can be varied according to the depth at which aeration is required.

In order to use the pump for circulating purposes (text-fig. 2) a number of tanks are connected up by siphon tubes, and the last of the series is similarly connected to a circulating jar. This jar is provided with a loosely-fitting bung of cork which carries, in addition to the siphon tube, a circulating tube and an air outflow tube from the pump. The circulating tube is about $\frac{1}{4}$ in. bore and extends from near the bottom of the jar up through the cork, and then back to the first of the series of tanks at a height as little as possible above the surface of the water in the tanks. The air outflow tube from the pump is drawn out and bent back so that it can easily be lodged in the lower end of the circulating tube.

From the description already given of the pump, it is obvious that the circulating pump fitted up in this way will work at a pressure equal to the water pressure at the tip of its air nozzle, that is, at the entrance to the circulating tube. Thus at this point air and water pass into the circulating

tube at equal and constant pressures. The pressure due to the mixed air and water in the uptake arm of the circulating tube is less than the water pressure at its lower end, and consequently the air and water are forced up the tube to the horizontal portion and so back to the first tank. As the water is pumped out of the circulating jar, more passes in from the last tank over the siphon tube, and so a continuous circulation is established. The only limiting condition in this arrangement is that the part of the uptake arm of the circulating tube above the surface of the water must not be too great in proportion to the part below the water, as then the pressure due to the mixed air and water in it will be greater than that of the air pump, and the air supply will simply bubble out of the bottom of the circulating tube.

The great advantage of this system is, again, that it is independent of the pressure of the water supplying the air pump, and consequently it will never stop, although it may slow down with variations in the main water-

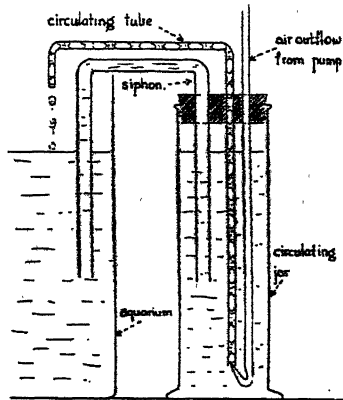


FIG. 2.—Circulating System.

supply. It will work at very low pressures. In our laboratories we have had a system circulating continuously for six months at only about 3 ins. water pressure.

We have described this apparatus mainly for those workers who wish to establish aquaria in their own laboratories. We have already emphasised that a water supply from the main is not necessary, and for this reason the pump is of great value for the establishment of tanks—especially marine tanks—in schools and museums. But it is obvious that the pump is a convenient form for general use in any laboratory.

That the system we have described is efficient in maintaining a balanced system of fauna and flora is demonstrated by the fact that we have kept alive in a perfectly healthy condition for ten months specimens of *Echinus mitiariis*, *Asterias glacialis* and *A. rubens*, various anenomes, *Cucumaria* sp. and *Sabella* sp. The two latter feed on minute suspended particles, so that our tanks maintain an efficient micro-fauna and flora.

XVIII.—A SIMPLY MADE HOT PLATE FOR FLATTENING PARAFFIN SECTIONS.

A. J. GROVE, M.A., D.Sc., University of Sheffield.

(Read October 19, 1927.)

ONE TEXT-FIGURE.

THIS device consists of a simple electric hot-plate on which a gradation of temperature can be obtained. In its simplest form (fig. 1) it can be made in the laboratory from any wooden box of suitable size (e.g., an ordinary chalk box) which has a lid sliding in a groove. The lid is replaced by a sheet of black glass which projects over one end of the box and slides freely in the groove. A hole is made in one end of the box to take an ordinary lamp

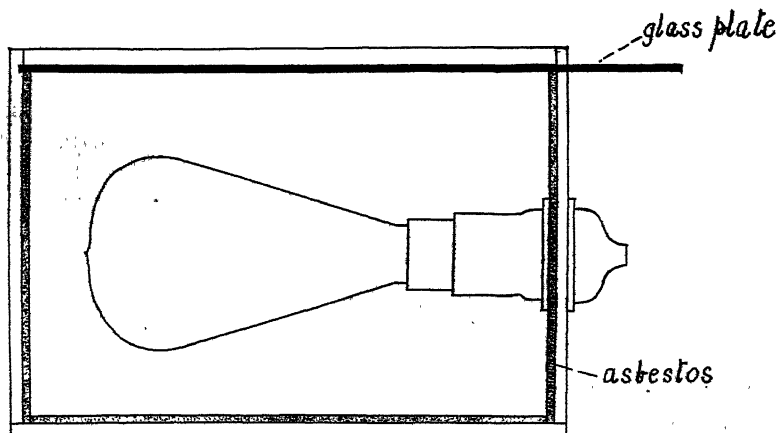


FIG. 1.

holder, the "shade nut" of the holder maintaining it in position. If desired, the box may be lined with thin asbestos board.

When the current is switched on, the heat from the lamp warms up the glass plate, and the hottest point is directly above the filament of the lamp. From this point the temperature of the plate gradually decreases until on the portion projecting over the edge of the box it is almost that of the room.

In practice, the slide of sections—which have been floated on water on the slide—is placed on the cold ledge and pushed along the plate until a

position is reached where the ribbons commence to flatten and expand. When the flattening process is completed, the slide can be brought rapidly to the cold area and the wax cooled. The gradation of temperature on the plate enables the flattening process to be watched and controlled to a nicety.

The apparatus is also convenient for straightening curved ribbons, because a place is readily found upon the plate which is just warm enough to maintain the wax in a sufficiently soft condition to permit the ribbon to be stretched and straightened.

It has been found that the device can be conveniently used for infiltrating small objects where it is desirable to avoid overheating. The infiltrating wax in a watch-glass can be moved about on the plate until a position is reached where the wax is just melted, so that the temperature to which it is subjected is practically that of the melting-point of the wax.

An elaboration of the apparatus by which the temperature of the hot point can be varied can be made by mounting the lamp on a movable shelf hinged to one end of the box. The shelf rests on an eccentric cam attached to a spindle operated by a handle outside the box, and by moving the cam the shelf and lamp can be raised or lowered as occasion demands.

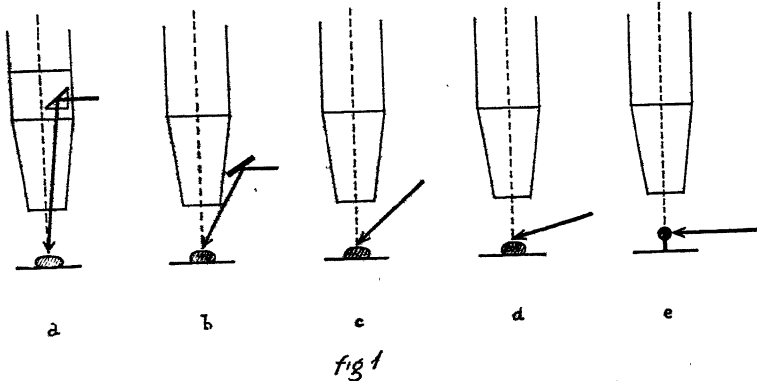
XIX.—MICROSCOPY WITH INCIDENT LIGHT AND ITS APPLICATION TO LIVING OBJECTS.

By PAUL VONWILLER* (Zurich).

(Read October 19, 1927.)

SIX TEXT-FIGURES.

ORDINARY microscopy requires, as a rule, a transparent object, transparency being easily obtained in fresh and preserved fragments of higher organisms. But if we search for transparent fields of observation in living higher animals, we are confined to a small number of objects, the best known being the blood circulation in the web of the frog's foot, pigmentary cells as examined by Lister (1858), and a few other structures. Although the advantages of



observations of the above are great, it is no exaggeration to say that the more interesting organs are excluded from direct observation. The rest of the integument of the frog and nearly all the interior organs cannot be examined, with the exception of the mesentery and the lung.

Microscopy with incident light opens the way to the observation of some hidden structures, but the method can only be of use in research if

* Investigations made with a subvention from the Foundation for Scientific Research of the University of Zurich (Switzerland).

it is of general application. The development of this method is largely dependent on recent improvements in sources of artificial light. With powerful modern illuminants (slit-lamp or Pointolite lamp) microscopy with incident light enables us to examine the external and internal organs of higher organisms. The eye of man as well as the skin capillaries are suitable objects.

We shall now develop the use of incident light, starting with obliquely incident light, as shown in c of fig. 1. It is obvious that such a method is applicable only to relatively small magnifications. When incidence approaches the horizontal, the light is unable to produce a microscopical

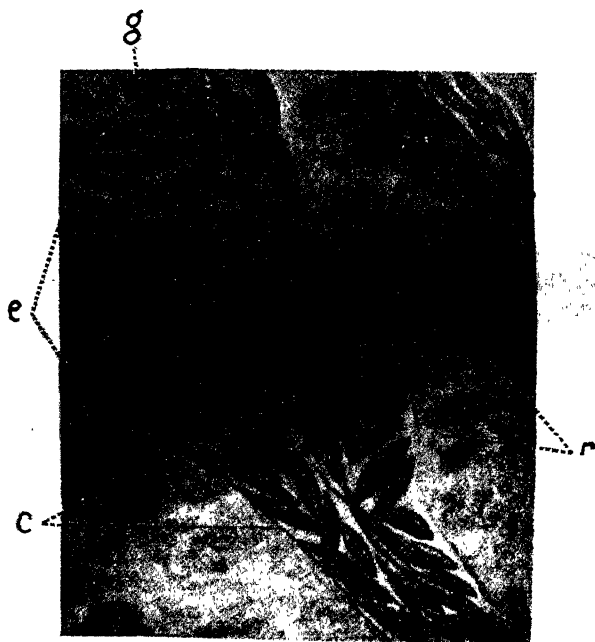


FIG. 2.

image. Such at least was the case in our experiments with the "Mignon lamp" of Leitz.

Our next experiments were made with vertical illumination. This method is used for researches upon such inanimate objects as metals or upon organic structures such as bone (Schmidt (1926)). Our investigations proved that it was applicable to many living structures, and that it permits the use of high-power or immersion objectives (Vonwiller (1923 and 1925)). The instrument was adapted to a slit-opakilluminator which allows greater exactitude in observation and better protection of the eye of the observer. It enables, for instance, the observation of blood circulation in the skin of the abdomen of a living frog (fig. 2). Red and white blood corpuscles

are easily distinguished as well as the granulations in the protoplasm of the latter.

The frog skin contains a layer of cells filled with crystals which act as reflectors. Many other bodies behave as reflectors in certain other objects, such as fat or the cell walls of plants. This is demonstrated clearly by the difficulty of obtaining a microscopical image in organs which do not possess natural reflectors, such as striated muscle. But we can create artificial reflectors (Vonwiller and Demole (1925)) by injecting metal powder emulsions in oil into the living tissues. Thus an artificial mirror is produced similar in its reflective action to the layer of cells in the frog's skin. Mercury

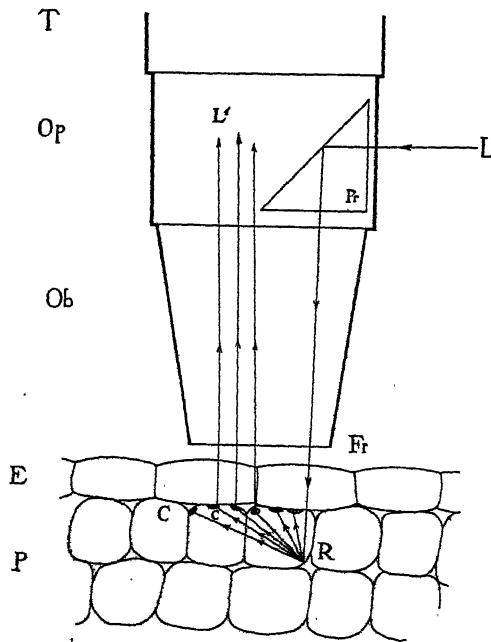


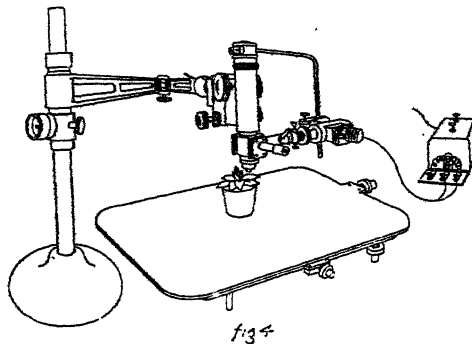
fig 3

droplets injected superficially are excellent artificial reflectors for observation of the finest structures of striated living muscle, *in vivo* and *in situ*, of the frog (Vonwiller and Demole (1925)).

It is conceivable that in vertical illumination light reflection plays a greater part than when using oblique incident light. When vertical incident light strikes a strongly reflecting surface, the reflected light can be so intense as to inhibit observation of deeper layers. In such cases a modification of the method is preferable; an illuminated point can be produced on the border of the visual field which serves as a light source for the portion of the object to be examined. In order to preserve the eye of the observer, an ocular diaphragm is placed over the illuminating point, so that only the object indirectly illuminated is seen (Vonwiller (1926)), as in fig. 3.

We have therefore a method of using obliquely incident light for the lower magnifications, and vertical direct or indirect light for the higher magnifications. Organic structures are, however, so varied that other modifications are necessary. If we wish to examine microscopically an object situated in the depth of a canal, the human tympanum, for instance, obliquely incident light is not applicable. Here we need vertically incident light in spite of the relatively low magnification. Such a scheme has been realised in the new ear-microscope of E. Luscher, where a "paravertical" illumination has proved itself to be the best. Light in this case falls vertically to the end of the objective and is reflected there by a metallic mirror in a direction approximating to the optic axis of the objective.

We stated before that with a Mignon lamp oblique incident illumination in higher magnifications was impossible. But the use of new modern sources of light changes things sensibly, an almost horizontal illumination (fig. 1d) being possible in many cases, and a truly horizontal (fig. 1e) one being realisable sometimes. The first steps in parahorizontal illumination were



made in collaboration with our colleague Dr. Herzfeld (Zurich). These investigations proved the utility of this method in research upon fibrous structures such as natural and artificial silk, and showed most striking differences caused by the use of light rays running parallel with the fibres or striking them at right angles.

Further observations proved that very characteristic results could be obtained in this way upon living objects also (fig. 4). For instance, the observation with higher magnifications of the blood stream in mammals was first obtained by vertical illumination and with an artificial reflector. These observations we repeated recently with the help of parahorizontal illumination, but without any artificial reflector, on the lower surface of the tongue of a young rabbit—i.e., upon a mammal without any operation, the injection of the narcotic excepted. This method was worked out quite recently, and enabled us to repeat the observation upon the conjunctiva bulbi of living rabbits with a very simple arrangement which will be described in a forthcoming paper.

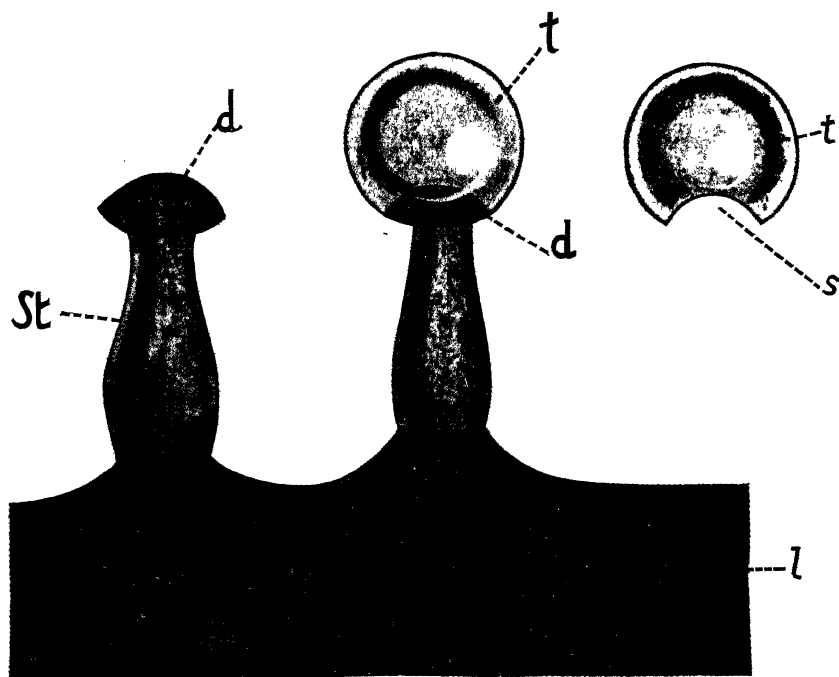


FIG. 5.

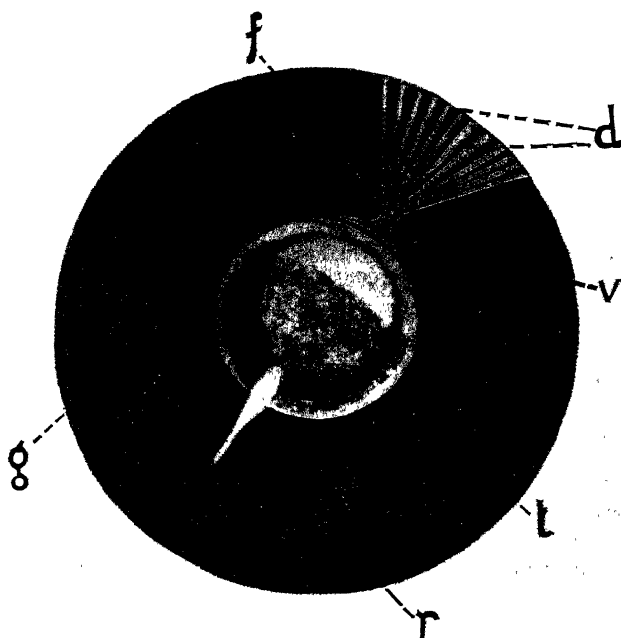


FIG. 6.

The importance, in certain special cases, of horizontal illumination was discovered during the investigations we made in the Department of Anatomy in University College, London. To the director, Professor Elliot Smith, and to his collaborators, especially Professor Singer, we are deeply indebted for the facilities which were given us whilst working there, as well as to Mr. Ogilvy, who lent us the instruments.

Our object was in this case, as in many preceding researches, the insectivorous plant *Pinguicula*. The droplets of secretion of its glands have a spherical form. In oblique as well as in vertical illumination we see the gland through the droplet, not in its natural size, but magnified (fig. 5). A high magnification is thus realised in a very unusual way, the droplet of secretion magnifying the original image. With high-power dry objectives the magnification is comparable to that of an oil immersion objective.

With the Pointolite lamp lent by Mr. Ogilvy we realised an exactly horizontal illumination, which is demonstrated by the following facts: on the same level on which we see the border of the droplet we also see the focus produced by the light rays, which converge towards it and diverge behind it. A characteristic reflection is seen on the side of incident light (fig. 6).

SUMMARY.

The preceding observations and experiments suggest that incident light opens up many new possibilities in microscopical research, and that all angles of incidence can be applied from vertical incident light through all intermediate stages to horizontal light. These applications can be made upon inanimate objects, but the most interesting applications are on the higher living organisms, plants, and animals. Some of these methods enable high magnifications to be obtained, and are applicable to problems of very general interest. They enable, for instance, the observation of blood corpuscles and blood parasites in living animals (Vonwiller and Demole (1925)), as well as other parasites which could not hitherto be perceived *in situ* with the ordinary methods of classical microscopy.

One of the most striking results of this system is that it draws our attention to an essential character of living tissues, namely, their optical properties—their natural colour, translucency, opacity, power of reflection, and the concentration of light by biological lenses. Moreover, it enables us to influence experimentally these characters, by artificial reflectors, which is as important a method in biology as the purely morphological investigation.

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XX.—STEREOSCOPIC VISION WITH THE MICROSCOPE.

By OSKAR HEIMSTÄDT.

(Read October 19, 1927.)

TWO TEXT-FIGURES.

STEREOSCOPIC vision—that is, vision with perception of the third dimension—can be obtained with the microscope in several ways.

One way is to use a microscope with two objectives (Greenough) whose images reach the eyes separately. Another way is to remove opposite halves of the images from two objectives and uniting the remaining rays (Emmich). This method has not been practically successful.

A further method (Wenham, Lealand, Abbe, Beck) makes use of a semi-transparent mirror whereby the rays pass partly direct through to one eye and partly by reflection to the other eye (physical division).

In this case the images in both eyes are identical. Under ordinary circumstances the result is a flat picture, but some stereoscopic effect is obtained on account of slight involuntary movements of the eyes. More can be obtained by making the interocular distance in the microscope greater or less than the interpupillary distance of the observer. A stereoscopic effect can also be obtained by cutting off opposite halves of the openings of the two oculars.

These methods are not fully satisfactory. The stereoscopic effect is obtained by sacrificing some of the intensity, sometimes as much as one half. The effect on the eye is exhausting. The methods also are not practicable with large magnification. Better results can be obtained in a different manner.

In 1852 Riddell showed that a stereoscopic effect could be obtained from a single objective by dividing the rays so that the two parts represent views with different perspectives (geometrical division).

In this case the eyes receive pictures that differ as if they came from different points of view. This method has now been practically applied in the microscope works of Reichert to the observation of the image formed by the objective.

In the first place the stereo-microscope consists of what may be termed the stereo-ocular or auxiliary microscope. This comprises all the parts shown in fig. 1 except the microscope objective. The semicircular case *P* carries the ocular tubes *K*₁ and *K*₂, and the lens tubes *B* and *A*. The image

from the objective, made smaller by the lens *V*, is formed just above the field lens *L* at the point marked by the arrows.

The auxiliary objective *O* consists of one pair of achromatic lenses corrected for this special purpose. It resembles an ordinary low-power objective, but has a larger absolute opening. Above the objective the rays are divided into two halves. Both halves are reflected by prisms to the oculars and reach the eyes separately. The two images are combined by vision into one. Since they differ in perspective in a way analogous to the

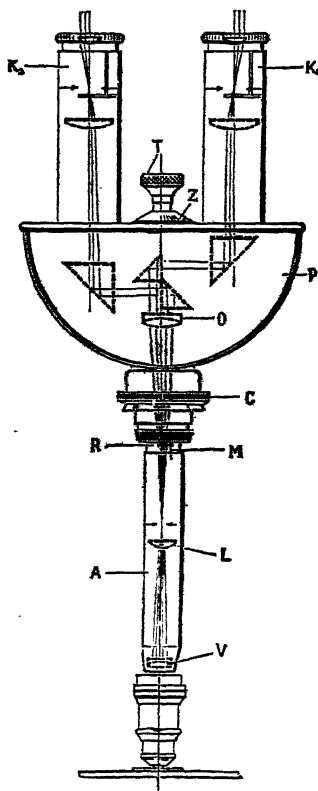


FIG. 1.

differences between the images attained in the eyes by ordinary vision, a stereoscopic effect results.

The oculars can be adjusted to the interpupillary distance of the observer by the milled head *T* fitted with an interocular scale at *Z*.

The stereo-ocular, used as a stereo-magnifier, is shown in fig. 2. Here the lens *V* has a focal length of 58 mm. With the lens at that distance from the field of view, the auxiliary microscope acts as a double telescope with a small stereoscopic effect. As *L* is removed further from *O*, the focus of the microscope comes nearer to the observer. The shortest distance of

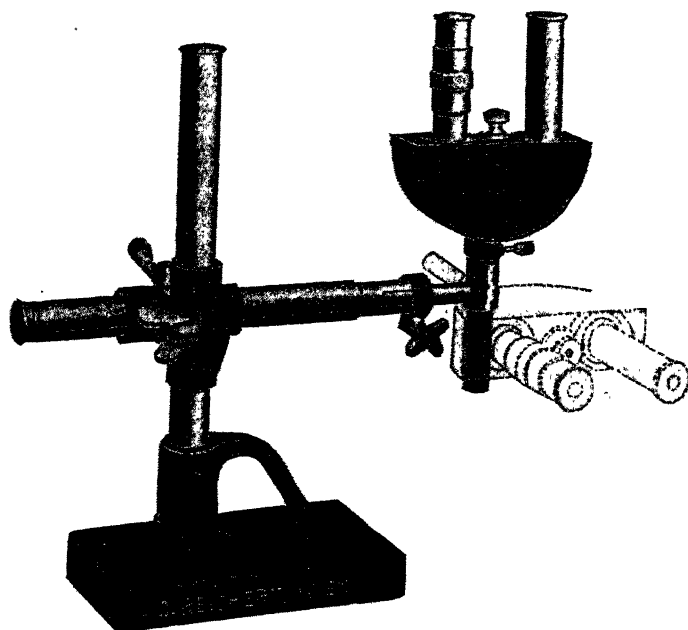


FIG. 2.

an object from the lens *V* permitted by the tube *A* is 107 mm. The following table gives the magnifications, etc., attainable with a pair of Huygens' oculars No. IV :—

STEREO-MAGNIFIER WITH OCULARS No. IV.

Extension of Tube in mm.	Distance of Object.	Distance of Object from Eyes.	Diameter of Field of View in mm.	Magnification.	Actual Magnification.
- 3	1,000,000	—	145,000	—	3½
0	780	1,050	113	1	4
+ 10	275	555	36	3½	7
+ 20	190	480	22	5½	10
+ 30	155	455	16	7½	13½
+ 40	130	440	12	10	17½
+ 50	118	438	12	12	1
+ 60	107	437	8½	14½	26
I	II	III	IV	V	VI

Column I gives the extension of the movable tube from the mark *M*. Columns II and III give the distance of the object from the lens *V* and from the eye. From column III it is evident that within a range of extension (column I) from 30 to 60 mm. the distance between the eye and the object changes very little. Changes in magnification can therefore be obtained with little alteration in the focusing. Column IV gives the diameter of the field of view. In column V the magnification refers to a range of distinct vision of 250 mm. Column VI gives the actual telescopic magnification. It is evident that the instrument acts as a telescope when used with an extension of -3 ; a field of view with a diameter of 145 m. corresponds to a distance of 1,000 m.

Two tubes of the form *A* are provided, one of them with a lens *V* of 58 mm. focal length for use as a magnifier, and one for 144 mm. for use with a microscope.

It is recommended that the adjustment of the interocular distance should be carefully made and noted down when the stereo-ocular is first used. After this, one only needs to adjust the oculars to this distance before the instrument is used. It is, however, to be noted that the distance of the semicircular "exit pupils" can be slightly varied according to the objectives and oculars used. Even the size of the opening of the diaphragm of the Abbe condenser is of influence, and readjustments may be necessary.

To focus the oculars both are pulled out somewhat beyond focus. The ocular which fixes the tube length is focused separately. Differences of refraction in the eyes are thus compensated. It is advisable to make note of the adjustments for each pair of oculars.

A particular property of the instrument is its excessive stereoscopic effect. If the "depth effect" were only proportional to the magnification, an object of $5\ \mu$ thickness would appear to be only 2mm. thick with 400-fold magnification. Nothing would be gained except an increased vividness of the images. The excessive "depth effect" makes it possible to locate points definitely in the depth. Either with strong dry or with strong immersion objectives stereoscopic vision produces the effect of looking into a glass box several centimetres deep.

The psychological stereoscopic effect is, however, several times greater than the actual physical effect. It is certain that the centres of the semicircular "exit pupils" are not to be taken as the perspective centres, which must be located rather towards the edges of the pupils. In other words, the outer parts of the exit pupils contribute more to the production of the stereoscopic effect. This remarkable phenomenon is particularly advantageous. The increased psychological effect is obtained without detriment to any physical effects such as magnification or intensity.

XXI.—NOTE ON A METHOD OF OBTAINING LONG WORKING DISTANCES WITH LOW-POWER OBJECTIVES.

By DOUGLAS P. WILSON, B.Sc.

(Read October 19, 1927.)

ONE TEXT-FIGURE.

It would frequently be useful to many scientific workers if on occasion they were able to increase temporarily the working distance of their microscope. Thus a biologist might glean some valuable information were he able to see under considerable magnification some organism living in an aquarium tank a few inches from the glass without disturbing it by removing it to a small dish or glass slip. The following is a simple and inexpensive method, applicable to most microscopes, by which this long working distance may be obtained.

The collar in which the draw-tube slides is unscrewed from the body of the microscope. At the lower end of the draw-tube there is in many instruments a thread on to which an objective may be screwed. For makes where this thread is not provided, an adapter could be made at a small cost. A $\frac{3}{8}$ -in. objective is screwed on, the draw-tube is pulled up through the collar to its fullest extent, and the whole replaced on the microscope. A 2-in. objective is in position on the nosepiece. It will now be found quite impossible to focus an object resting on the stage; but if the condenser be removed, an object held below the stage at a distance of about $3\frac{1}{2}$ in. from the 2-in. objective will be seen sharply defined at a magnification of about 30 diameters (using a x6 eyepiece). If the draw-tube be pushed in a little so as to bring the two objectives closer together, it will be found that the working distance is increased while the magnification is less. The following very approximate figures, obtained on a "Service" microscope, using a Watson parachromatic $\frac{3}{8}$ -in. objective and a 2-in. objective supplied by Flatters & Garnett, Ltd., in conjunction with a x6 eyepiece, will give some idea of the range of working distance and magnification obtainable.

Position of Draw-tube.	Working Distance.	Magnification.
203 mm.	3.7 in.	x34
194 mm.	6 in.	x11
184 mm.	18 in.	x5
		2 A

The image is perfectly sharp, the resolution excellent, and at the same time a good depth of focus is obtained. Still higher magnifications may be obtained by using a higher power eyepiece. If the objectives are brought still closer together than is indicated in the above table, a quite serviceable telescope results.

It will be seen that the principle employed is virtually that used in the "Davon" super-microscope, and, indeed, it was after examining one of those instruments that I was led to experiment with my own "Service" model and thus find the extremely useful combination described above. Doubtless other combinations will give similar results; a Watson para-chromatic $\frac{1}{8}$ -in. objective used in place of the $\frac{2}{3}$ -in. was very satisfactory,

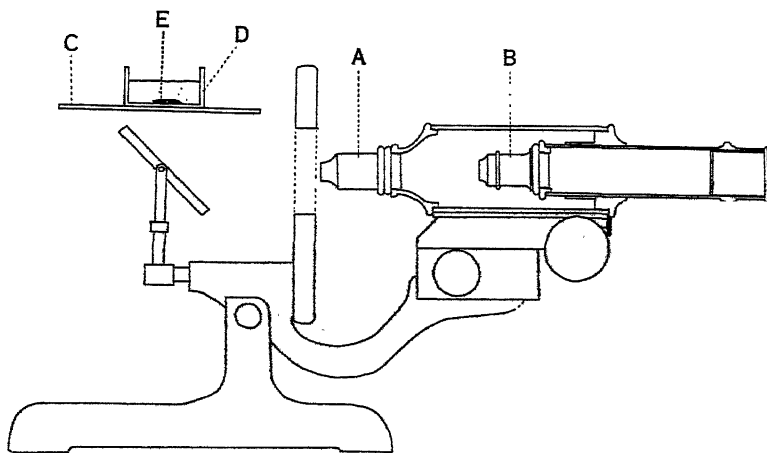


Diagram to illustrate method of observing the ventral surface of an animal crawling on the bottom of a glass dish.

- A. 2-in. objective.
- B. $\frac{3}{4}$ -in. objective.
- C. Sheet of glass. This is supported on both sides of the microscope.
- D. Glass dish.
- E. Animal under observation.

but I have had no success with higher powers. A Leitz $1\frac{1}{2}$ -in. objective used in place of the 2-in. gave still higher magnifications at about the same working distances. Not all 2-in. objectives will work in this way, but the majority I have tried do so. Those which gave no result were of the single lens type.

The image is erect, and from this follows the very useful expedient that by removing the condenser and mirror the ordinary microscope makes an excellent dissecting instrument, the object to be dissected being placed in a small dish on the bench below the hole in the stage. The position is a most comfortable one in which to work, and there is, of course, plenty of room between specimen and lens.

One other use of this combination which deserves mention is the ability to see in ventral view animals crawling freely on the bottom of a clear glass dish. The dish is supported in such a manner that the mirror can be brought directly underneath when the microscope is used in the horizontal position, and the reflected image is then focused by the combination. As one would expect, there is a slight loss of sharpness due to the formation of a faint double image, but this does not, as a rule, prevent observations from being made which otherwise might be practically impossible. The defect could be overcome by using a mirror silvered on the surface. Doubtless many other uses will suggest themselves to workers according to their individual needs.

[The principle of forming an image in air with an objective in the substage and treating that image as a real object which is magnified with another objective in the nosepiece was described by J. J. Lister in 1882, the original manuscript being now in the Society's library. E. M. Nelson, in a communication to the *English Mechanic* (April 4, 1913), also refers to the fact that Benjamin Martin (*circa* 1750) and Goring have used the same principle.—ED.]

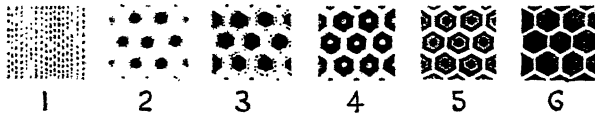
XXII.—NOTES ON DIATOM STRUCTURE AND RESOLUTION.

By CONRAD BECK.

(Read October 19, 1927.)

ONE TEXT FIGURE.

I AM exhibiting a specimen of *Pleurosigma angulatum* shown with a $\frac{1}{12}$ in. apochromatic object glass 1.4 N.A., with dark ground illumination. The illuminator is a special fixed focus form which admits light between 1.43 and 1.5 N.A., and is only suitable for use with objects mounted in balsam or media of a higher refractive index. If the objects are in water, none of the light enters, and therefore the illuminator has not a general application. The appearance of *Pleurosigma angulatum* with this high-angled object glass, and under dark ground illumination, is different from any published photographs, and does not seem to have been described before. It consists of a series of black spots somewhat hexagonal in shape with a white dot in the centre. If by means of an iris diaphragm behind the lens the aperture is reduced to 1.2 N.A., the central white dot disappears.



To explain this, a specimen of *Triceratium favus* is shown in another microscope under a 16 mm. apochromatic lens .35 N.A. It has an iris diaphragm between the object glass and the body of the microscope. When the aperture of the iris diaphragm is closed to a pinhole, all structure disappears (fig. 1) in the image of the diatom. As the diaphragm is gradually opened, a series of different images are observed, as shown in the diagram figs. 1 to 6; first (fig. 2) a series of circular fairly small dots resembling the effect which we are in the habit of calling resolution with a fine diatom under a high power, next the dots become larger (fig. 3), with some indication of a shape. The next image (fig. 4) shows a white dot in the centre of a dark hexagonal dot and resembles the appearance of *Pleurosigma angulatum* shown with the $\frac{1}{12}$ in. 1.4 N.A. A further opening of the iris diaphragm (fig. 5) shows the white spot changed into a hexagonal fine white line which travels outwards and is finally merged into the hexagonal margin of the

black dot, and becomes the well-known hexagonal structure of *Triceratium favus* (fig. 6). The further secondary structure of this specimen is not shown, as it requires an object glass of still greater aperture.

These images are probably capable of explanation by consideration of the diffraction images. The object that is producing the images consists of a series of luminous short lines arranged in a honeycomb manner as the margins of hexagonal spaces. The image of a point seen through the microscope is a disc surrounded by rings. The image of a line is a band flanked by lines on each side. The size of the discs and bands depends on the aperture of the object glass, and when the aperture is sufficiently small, the bands overlap and no structure is visible, as the bands are reduced in size due to increased aperture. A black space between the hexagonal bands produces the black dot image. Upon further reduction the first set of flanking lines comes into a position where they all coincide, and although they are much less intense, they overlap and reinforce one another, forming a white dot. After that, they travel outwards towards their main band images until finally they cannot be separated from their respective line images, and one may conclude that the image approximates to the true structure.

If this is the correct explanation of the phenomena, one is impressed with the fact that the resolution of *Pleurosigma angulatum*, as shown by a $\frac{1}{12}$ of 1.4 N.A., is a very imperfect guide to what the actual structure may be, because on the coarse diatom when the aperture is such that the image (fig. 4) is seen, the aperture must be about doubled to give the true hexagonal structure.

We may surmise that the structure of *Pleurosigma angulatum* may be similar to that of *Triceratium favus*, but it can only be a guess, as the same appearance can be produced by a different structure.

Although the structure of the diatom can only be inferred from the presence of the white dot, it does give us a fairly reliable indication of the resolving power of the lens used, and if, for instance, this white dot image can be shown by a lens of lower aperture by the use of ultra-violet light, this is a useful index of the resolution that may be reached by this means. Mr. Barnard has taken a photograph of *Pleurosigma angulatum* with ultra-violet light with an aperture of less than .8 N.A., which shows the white dot which with green light can only be seen with an aperture of about 1.2 N.A.

The study of a coarse diatom, the structure of which is known, is interesting from another point of view. Such a diatom examined with a small aperture enables all the curious images to be seen that are due to oblique and incorrect illumination; the dots can be made to appear triangular, rectangular, convex or concave, by varying the obliquity and character of the light.

XXIII.—ABSTRACT OF A PAPER ON
A NEW DEVELOPMENT OF THE ULTRA-MICROSCOPE.

Communicated by F. CARREL.

May 18, 1927.

ONE TEXT-FIGURE.

THE paper describes an illuminating system designed by Ch. Spierer, of Geneva, for dark-ground illumination by visible and ultra-violet radiations.

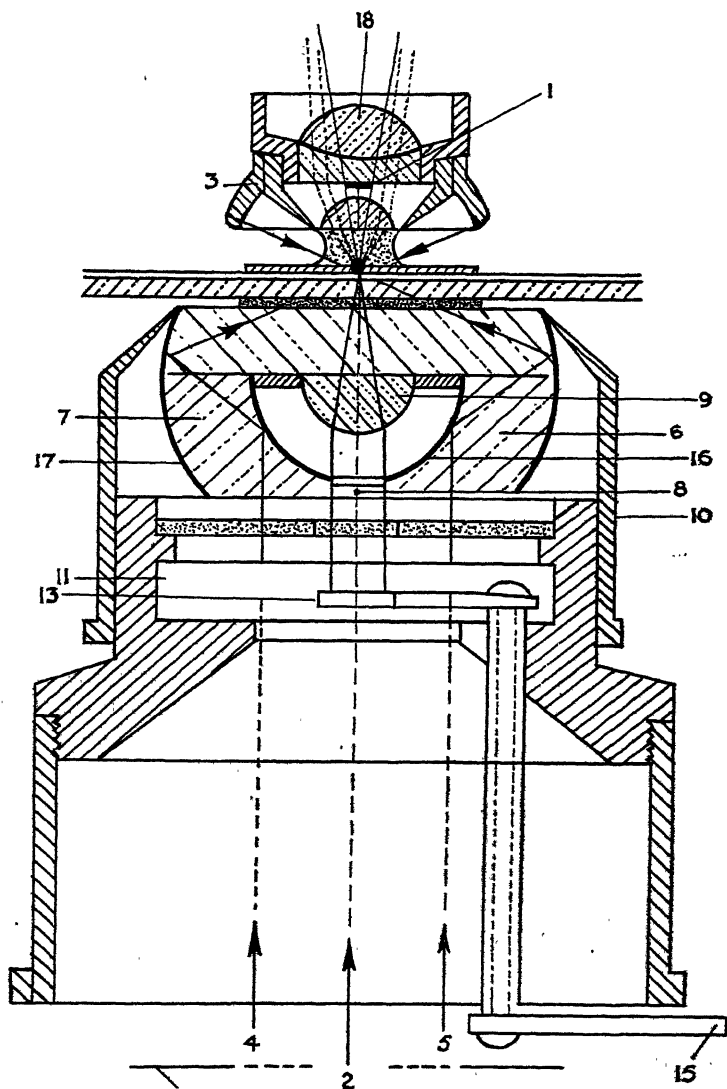
The condenser is so constructed that the object may be illuminated by an annular cone of rays, or by a narrow axial pencil of light, or by both. It consists of two spherical reflecting surfaces by which the rays from the illuminating source are twice reflected to form an annular cone before coming to a focus upon the object. Only light scattered from the object enters the objective to give a dark-ground image. The axial portion of the system is perforated to allow the axial beam to pass through the reflecting surfaces and to fall upon a refracting surface which focuses this beam upon the object. In the ordinary way this beam would be collected by the objective to form a transmitted image, but to obtain a dark-ground picture a metallic stop, the lower face of which is a reflecting surface, intercepts this beam and refocuses it upon the object. Here again only light scattered by the object is picked up by the objective. The light focused upon the object by the reflecting surface, and which passes through the object, misses the objective completely, but this is also refocused upon the object by a reflector of the Lieberkuhn type.

By means of a central stop the axial beam may be cut out while allowing the annular cone to illuminate the objective, or alternatively this stop may be removed to allow the former to pass while the latter may be cut out by means of an aris diaphragm.

Two colour filters may be inserted in the condenser, so that each illuminating beam may be composed of different colours.

The paper is illustrated by one diagram and three photographs.

J. E. B.



A REVIEW.

THE GOLGI APPARATUS OF PROTOZOA.

BY S. D. KING, B.A., M.Sc., Ph.D. (Dubl.).

SEVEN TEXT-FIGURES.

THE study of the cytoplasmic inclusions in protozoa has attracted so much attention among cytologists in recent years, and so many views as to the nature and functions of these inclusions have been put forward, that a review of recent work in this field is badly needed.

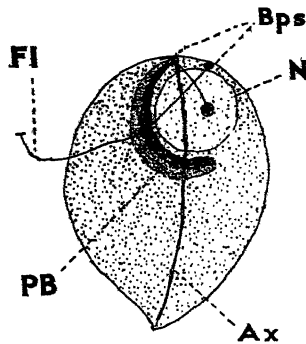


Fig.1

Monocercomonas melolonthæ. PB. parabasal, Ax. Axostyle, Bps. Blepharoplasts, Fl. Flagellum, N. Nucleus. After Grassé. (This and the succeeding figures are more diagrammatic than the originals.)

The presence of mitochondria, in the form of rods and grains, in many protozoa, has been long established by the work of Fauré-Fremiet and others, and protozoan mitochondria seem to differ in no important respect from those of metazoa, and exhibit a certain uniformity in the examples so

far studied. In the case of the Golgi apparatus, however, the position is of greater interest. At least five different types of supposed Golgi bodies have already been described in protozoa, and some at least of these indicate the possible ancestral type of apparatus. In this review it is proposed to give a concise account of the evidence on which the various theories as to the structure and function of the protozoan Golgi bodies are based.

The first record of the presence of a Golgi apparatus was that of Hirschler (1914), who succeeded in demonstrating a series of osmiophile rings and crescents in the cytoplasm of *Monocystis ascidiae*. These were preserved only by the methods suitable for the demonstration of the metazoan Golgi apparatus, and bore a striking resemblance to the elements of the latter. Mitochondria, distinct from the Golgi elements, were also demonstrated in this gregarine. Strange to say, Hirschler did not follow up this pioneer work, and the question of the presence of Golgi bodies in the protozoa was allowed to lapse for several years. Hirschler's work was confirmed almost simultaneously by King and Gatenby (1923) in Dublin and Joyet-Lavergne (1923) in Paris. The former described a normal Golgi apparatus in several stages of *Adelea ovata*, the latter in *Adelina dimidiata*. After this, Golgi elements were described in a number of different gregarines and coccidia by Joyet-Lavergne (1924-26) and in *Haplosporidium* by King (1926). By this work the presence of a normal Golgi apparatus in at least three groups of the sporozoa has been definitely established.

The Golgi apparatus described in all these sporozoan forms is of the type already familiar in metazoan germ cells, viz., discrete rods and granules, often clumped near the nucleus in early stages, and later spreading out through the cytoplasm. In *Haplosporidium* the apparatus seems to remain juxta-nuclear throughout most of the life history, but is not otherwise more primitive than the coccidian and gregarine type. It is obvious, therefore, that the Golgi apparatus of the sporozoa can be of little help in determining the probable nature of the ancestral type of Golgi element. It merely confirms the evidence of metazoan germ and embryonic cells, which show that the concentrated juxta-nuclear apparatus is a primitive type. As will be seen, however, the apparatus in certain of the forms studied by Joyet-Lavergne seems to indicate a connection with the "parabasal" type of apparatus described by Duboscq and Grassé (1926) in flagellates (text-fig. 2).

The function of the Golgi apparatus in sporozoa is, in some cases at least, probably secretory. In *Adelina*, Joyet-Lavergne (1924) brings forward evidence to show that the lipid granules of the gametocyte are derived from the Golgi elements, and in the case of *Haplosporidium* the fatty spheres found in the spore are probably also formed under the influence of the Golgi apparatus (King (1926)). Another interesting fact, recorded by Joyet-Lavergne (1924 and 1926), is the presence, at the anterior end of the sporozoite and microgamete (the stages in the life-history which penetrate other cells), of small anterior Golgi elements, which he compares to the

acrosome of the spermatozoon (text-fig. 2). These bodies are found in *Aggregata* and various other forms.

The great difficulty attending the demonstration and interpretation of the cytoplasmic inclusions in protozoa can best be realised when we find that so prominent a cytologist as Hirschler (1924) has been led to an erroneous conclusion by a study of several forms. He has succeeded in demonstrating a Golgi apparatus distinct from the mitochondria in *Monocystis ascidiae* and *M. agilis*; but in the same paper he states that in *Gregarina polymorpha*, *G. blattarum*, *Spirostomum ambiguum* and *Opalina ranarum* only a single type of lipid inclusion is present. These inclusions are interpreted as representing both mitochondria and Golgi bodies.

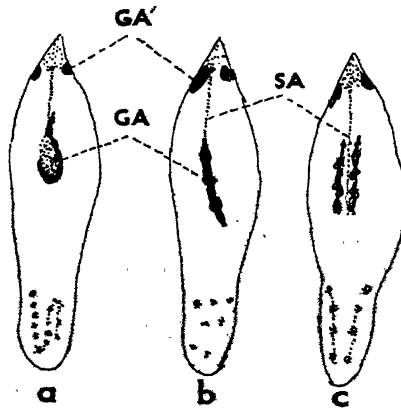


Fig.2

Three stages of the Golgi Apparatus in schizozoites of *Aggregata eberthi*. GA. Golgi apparatus, GA'. Anterior Golgi rodlets comparable to an acrosome, SA. "siderophil axis."

Adapted from Joyet-Lavergne.

Hirschler believes this to be the primitive condition, the differentiation to mitochondria and Golgi elements only occurring in the more highly organised forms. Joyet-Lavergne has shown that at least in sporozoa the Golgi elements are always quite distinct from the mitochondria. He has demonstrated typical Golgi bodies in a large variety of gregarines and coccidians, including *G. polymorpha*. In *Opalina*, as will be seen later, a second category of lipid inclusions has been described by King and Gatenby (1926) and by Sokolska (1927), although their homology with the Golgi bodies cannot yet be said to be conclusively proved.

The flagellates are by some considered to be the most primitive group of the protozoa. The question of the nature of the Golgi apparatus in this group is therefore one of especial interest, and the work of Duboscq and

Grassé in the last three years has done much to elucidate this problem. These authors advance very strong evidence in support of their view that the parabasal apparatus of flagellates is the homologue of the Golgi apparatus of metazoan germ cells. Both parabasal and Golgi elements are usually destroyed, or greatly altered, by fixatives containing acetic acid. In the case of the *Herpetomonads* and *Bodos* the parabasal apparatus persists apparently unchanged after such fixation, but this only shows that here the proportion of proteid to lipid matter is higher than in other forms. Similar differences of resistance may be found in metazoan Golgi bodies. Parabasal and Golgi elements alike can be demonstrated after mitochondrial fixatives by iron hæmatoxylin staining, and can be impregnated by osmium or silver according to the classical Golgi apparatus techniques. In many cases parabasal bodies show the typical chromophile-chromophobe structure of metazoan Golgi elements (text-fig. 1). In all cases which have been thoroughly studied, the parabasal has been seen to divide at cell division. In *Lophomonas blattarum*, Kudd (1926) states that the parabasal arises *de novo*, but as he does not believe it to be homologous to the parabasals of other flagellates, this does not affect the present issue. The parabasal is invariably associated with the blepharoplast or centrobalepharoplast, recalling the familiar arrangement of the Golgi bodies in relation to the centrosome in metazoa. Finally, in some cases at least, there is evidence that the parabasal apparatus is, like the Golgi apparatus of many cells, concerned in secretion. Thus in *Trichomonas batrachorum* and *Tetramastix bufonis* droplets break off from the chromophobe substance of the apparatus and fall into the cytoplasm, where they seem to be dissolved (Grassé (1926)). A very similar phenomenon is described in *Trichonympha chattoni* by Duboseq and Grassé (1927).

All this evidence seems to point to the identity of the parabasal apparatus of flagellates with the Golgi apparatus of metazoa and sporozoa, and in some cases a close morphological resemblance exists between them. In the case of the sporozoan Golgi apparatus Duboseq and Grassé (1926) note the resemblance of the parabasal of *Pseudotrichonympha* to the Golgi apparatus of the schizozoites of *Aggregata eberthi* described by Joyet-Lavergne (1924), and of certain strongly polarised nerve cells, such as the rods and bipolar cells of the retina. In the case of *Aggregata* the Golgi apparatus is, in young schizozoites, in the form of a crescent, connected with the centrosome by the "siderophile axis." Later, the crescent straightens out to form a rod, which then splits, half lying on each side of the axis (text-fig. 2). It is this stage which strongly recalls the parabasal apparatus of *Pseudotrichonympha*, which consists of two parallel "suspensory filaments" leading from the blepharoplast toward the nucleus. We see, then, that the rod-like type of parabasal, so characteristic of the Poly- and Hypermastigina, has its parallel in the Golgi apparatus of some sporozoan and even of some metazoan cells. In some cases the form of the parabasal strongly suggests the type of Golgi apparatus familiar in the gametogenesis of many metazoa. In *Holomastigotes*,

as described by Duboscq and Grassé, the parabasal bodies, which multiply with the growth of the organism, are in relation to the subflagellary filaments of the flagellated spirals, and have the form of a chromophil cap surrounding a chromophobe substance (text-fig. 3). In *Pyrsonympha vertens* the parabasal bodies are typical curved dictyosomes applied to the nuclear membrane.

Grassé (1926) asserts that the parabasal apparatus is present in all Protomastigina. In Herpetomonads and Bodos it resists acetic acid to a

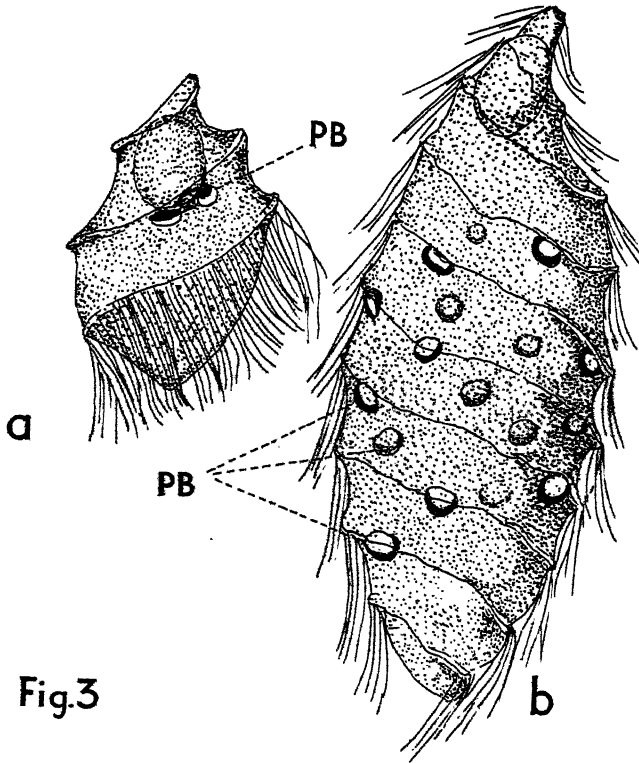
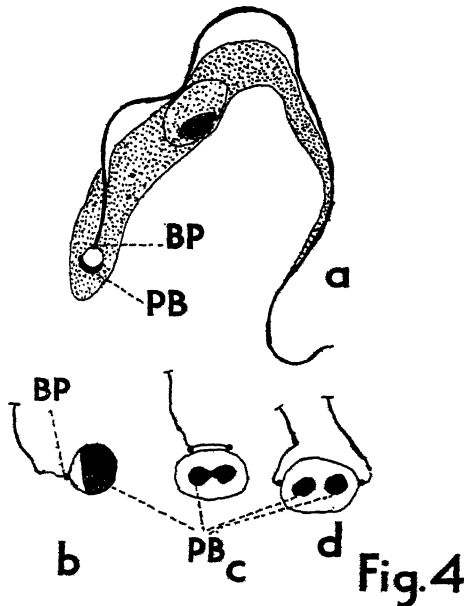


Fig.3
Holomastigotes elongatum. (a) Young stage showing first division of the parabasal body, (b) Adult. Numerous parabasal bodies suspended from the flagellated spiral.
 After Duboscq and Grassé.

remarkable degree, and has consequently been familiar to protozoologists for many years under the name of kinetonucleus. In these groups there is no obvious differentiation to chromophil and chromophobe parts, but in Herpetomonads the clear space surrounding the "kinetonucleus" proper—a "space" which can be stained *intra vitam* and is, therefore, not an artefact, may correspond to the chromophobe substance. This view is supported by the appearance often seen in fixed and stained specimens of *Trypanosoma brucei*, in which the chromophile "kinetonucleus" may form a kind of cap, separated from the blepharoplast by the clear substance

(text-fig. 4(a)). Wenyon (1926), working on *T. rhodesiense*, concludes that the blepharoplast is united to the parabasal (kinetonucleus) by a membrane. He states that, in degenerating trypanosomes, "the axoneme will be seen to terminate in the blepharoplast, which appears to be lying on the surface of a membrane connecting it with the parabasal. If the parabasal were a free and independent structure, it would be expected that in disintegration or cytolysis the parabasals would not remain united, as they appear to do. Dividing or already divided blepharoplasts and parabasals still show this connection with one another, and with the axoneme



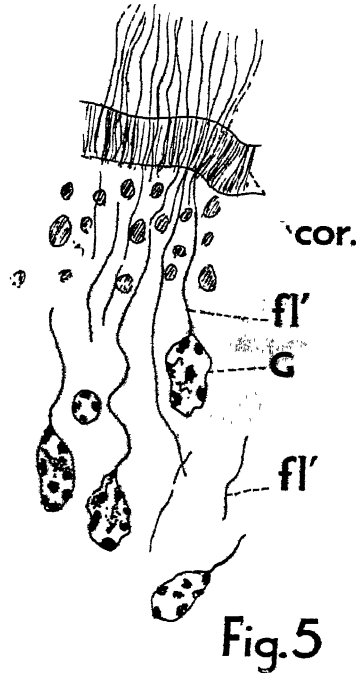
(a) *Trypanosoma brucei*, after Grassé. (b, c and d). Relations of the parabasal apparatus and blepharoplast before and during division in degenerating *T. rhodesiense*.
After Wenyon.

of the flagellum" ("Protozoology," Wenyon, 1926). If we consider the clear substance enclosed by the "membrane" as the chromophobe part of the parabasal apparatus, we can explain the appearances figured by Wenyon (text-fig. 4 (b, c and d)) on the assumption that the chromophil substance (parabasal of Wenyon) divides first, the division of the chromophobe part following later.

As regards the physico-chemical properties of the parabasal apparatus, the general facts have already been mentioned. The slow reduction of OsO_4 , coupled with the facts that the apparatus stains red with Sudan III, and is alone stained after the Smith-Dietrich reaction, points to the

conclusion that it is of lipid nature. As in metazoan Golgi bodies, however, there is a greater or lesser proportion of proteid always present. The refractive index of the apparatus is nearly similar to that of the cytoplasm, but in some cases the parabasal can be seen *in vivo*. Intra vital staining is exceedingly difficult, but Grassé has succeeded in some cases by using a 1/30,000 solution of Janus B. Neutral red does not stain the parabasal.

In the Euglenoids, Grassé considers that the stigma, which has already been compared to the kinetonucleus by Alexieff (1912), represents the



Part of a section of *Opalina ranarum* showing osmiophile bodies attached to the cilia. Cor. Cortex, fl. intraendoplasmic part of the cilium.

After King and Gatenby.

parabasal apparatus. In support of this view he urges (1925 and 1926) that the stigma and parabasal have the same reactions to fixatives (susceptibility to acetic acid, slow impregnation by osmium and silver); that the stigma is composed of a proteid (chromophobe) basis, in which are scattered lipid (chromophil) spherules, which may or may not (*Astasia*) be coloured by carotin; and that it multiplies by fission at cell division, and is in close relation to the blepharoplast, although not actually connected with it.

The evidence brought forward by Grassé in support of his parabasal Golgi apparatus theory is very strong; we have not only the chemico-physical

resemblance between the parabasals and Golgi bodies of metazoan germ cells, but also the constant association of the former with the blepharoplast. Gatenby (1928), writing on the Golgi apparatus of protozoa, suggested that "the Golgi bodies probably arose in connection with the terminal bead of the flagellum of some primitive flagellate. . . . From its primitive position in the metazoan cell, always associated at some time with the centrosome-centrosphere complex, we cannot but believe that in the early history of the cell the Golgi apparatus and the centrosome were evolved side by side. . . ." The work of Duboscq and Grassé has done much to confirm this view, which was advanced on purely theoretical grounds.

In *Opalina ranarum* King and Gatenby (1926) have described a lipid

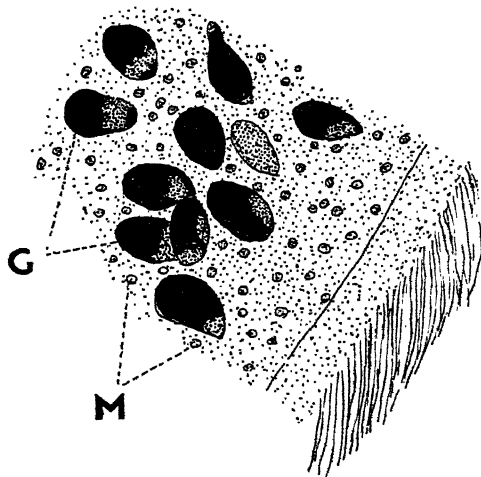


Fig. 6

Part of a section of *Anoplophrya brasili*, showing mitochondria (M), and supposed Golgi bodies (G).
After King.

cell constituent which they believe to represent the Golgi apparatus of this organism, and which strongly recalls Grassé's work on flagellates. The cilia of *Opalina* pass down into the endoplasm, where each connects with a pyriform body, giving the same reactions as the parabasal, except that it can be stained with ease *intra vitam* with neutral red (text-fig. 5). Sokolska (1927) states that each one is accompanied by a "lipoidiferous membrane" which forms a loop around it. This work will be referred to later in connection with Nassonov's contractile vacuole theory.

Bodies recalling the supposed Golgi bodies of *Opalina* have been described by King (1926) in *Anoplophrya brasili*. These bodies are pyriform (text-fig. 6) with a very distinct differentiation to chromophile and chromophobe

parts. They are distinct from the mitochondria, which are small and granular. The chief difference between these bodies and those found in *Opalina* is the absence, in *Anoplophrya*, of any connection with the basal granules of the cilia. Grassé (1926) points out that in flagellates such as *Trypanosoma* the parabasal may be destroyed without affecting the activity of the flagellum, and suggests that its constant association with the blepharoplast may be due only to the polarising influence of the latter. On this assumption it is easy to imagine that, with the localisation of the basal granules in the cortex of the Ciliophora, the Golgi elements should lose their connection with them, and remain to carry on secretory activity in the endoplasm. It is even possible, with our present knowledge, to trace the probable stages by which the apparatus of *Anoplophrya* might have been derived from a simple parabasal. Starting with a form like *Monocercomonas* (text-fig. 1), in which the parabasal is a simple curved rod attached to the blepharoplast, we proceed to a form like *Holomastigotes* (text-fig. 3), where, in correlation with the multiplication of the flagella, the parabasal also multiplies, the numerous parabasal bodies retaining a connection with the flagellated spirals. From this the transition to the *Opalina* type is simple. The chief difference between *Holomastigotes* and *Opalina* is, in this connection, the fact that in the latter the parabasal elements are directly connected one to each flagellum (cilium), while in the former the parabasal bodies are less numerous than the flagella, and are suspended from the subflagellary filament. It may be that the condition in *Anoplophrya* has been evolved directly from some such form as *Holomastigotes*.

The two remaining types of Golgi apparatus which have been described in protozoa differ markedly from those discussed above. In *Entamoeba* Causey (1925) has described what he considers to be Golgi elements, arising from food vacuoles. The wall of a disappearing vacuole is sometimes seen to thicken at one side, forming a deeply staining crescent, which may later become twisted and complicated to give a net-like appearance. This interpretation differs widely from accepted views as to the origin of Golgi bodies. The walls of the food vacuoles are composed of the part of the ectoplasm which happened to come in contact with the food particle when it was being ingested; Causey's theory would therefore infer that in *E. gingivalis* the Golgi bodies arise *de novo* from the cytoplasm. This author's technique (smears fixed in osmic vapour and preparations stained *intra vitam*) is inadequate if used as a basis for the identification of a type of Golgi body completely different from any previously described, and his work needs the corroboration of preparations made by the standard Golgi apparatus techniques before it can be accepted.

The work of Nassonov (1924 and 1925) on the contractile vacuole of ciliates and flagellates introduces to us the last, and perhaps the most interesting, type of Golgi apparatus described in the protozoa. This author finds that the contractile vacuole is, as has long been suspected, surrounded by a

permanent membrane. This membrane resembles the Golgi apparatus of metazoan cells in being almost or quite invisible *intra vitam*, and in being of a lipoid nature, as shown by its power of slowly reducing OsO_4 . It bears a remarkable resemblance to the simple vesicular type of apparatus found in the choanocytes of sponges and in many germ cells. Perhaps the most forcible argument put forward by Nasonov in favour of his theory is the function which he assigns to the osmiophile membrane of the contractile vacuole. In order to explain the working of the vacuole, he assumes that the lipoid membrane must be semi-permeable, and that its contents must be of higher osmotic pressure than the surrounding cytoplasm. Under these conditions fluid would flow into the vacuole until it was completely distended, when the pressure would burst the membrane, the fluid being thus ejected. The membrane, being of a viscous consistency, would immediately mend itself again, but in order to induce a fresh inflow of fluid into the vacuole a new supply of osmotically active substance would be necessary. Nasonov (1924) noticed small vacuoles forming, after systole, in the substance of the osmiophile membrane of *Campanella*, and later breaking into the central vacuole. This condition he took to be pathogenic, but Fauré-Fremiet (1925) has been able to follow out the same process *intra vitam*, and states it to be normal and constant in *Campanella* and other forms. Nasonov assumes that the osmiophile membrane secretes the osmotically active substance necessary to the working of the vacuole, and pours it into the latter after each successive systole, and the appearance of the small vacuoles described above certainly bears out his view. This secretory activity of the osmiophile membrane is compared to the secretory activity of metazoan Golgi bodies in gland and other cells. In secretion by the Golgi apparatus Nasonov distinguishes two phases, first that of "bound secretion," in which the secreted substance is imprisoned in the interior of the Golgi element, and, secondly, "free secretion," when the secreted substance is released into the cytoplasm. In the contractile vacuole of the type described above (text-fig. 7 (a)), the only parallel of "free secretion" is the watery substance which has been shot out of the body, but in *Chilodon* and *Dogielella* Nasonov has found another type of excretory apparatus, showing a much greater resemblance to the metazoan Golgi apparatus. In these forms a permanent osmiophile ring surrounds the contractile vacuole (text-fig. 7 (b)). After systole numerous small vacuoles (bound secretion) appear in the substance of the ring; these then run together to form a large vacuole enclosed by the ring, but quite free from it (free secretion). This, the true contractile vacuole, has no visible membrane, and Nasonov concludes that the surrounding cytoplasm, in contact with the watery contents of the vacuole, acts as a semi-permeable membrane. Once formed, the contractile vacuole does not increase in size, but bursts to the exterior. Nasonov compares such a ring-shaped "excretory apparatus" with the ring-shaped Golgi apparatus found in many metazoan cells, and gives some convincing figures showing the resemblance (text-

fig. 7 (c)). In *Dogielella*, in a stage preceding division, he figures a second small vacuole, with its ring, in the cytoplasm (text-fig. 7 (b)), but unfortunately he has not been able to determine its origin. In *Paramœcium* he has shown that in abnormal individuals with three or more contractile vacuoles, the extra ones are formed as offshoots of the original ones, i.e., by division, but whether or not this is the case in normal cell division we do

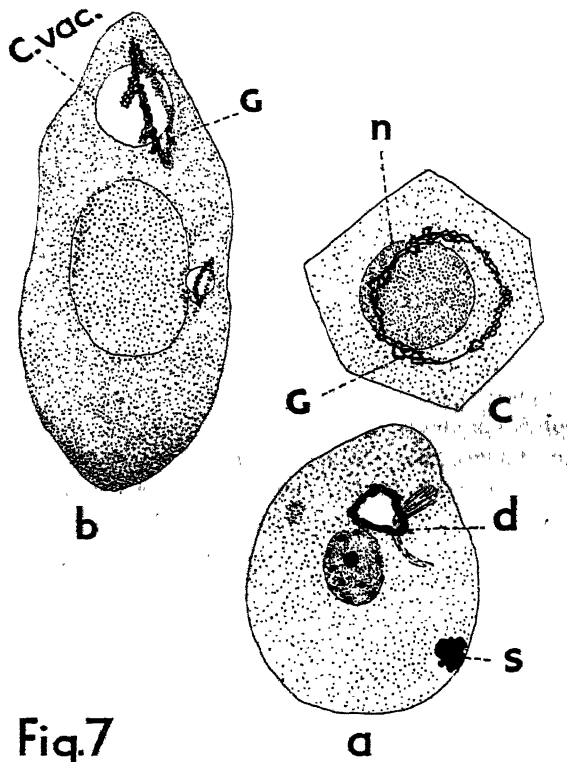


Fig.7

(a) *Nassula laterita*, showing contractile vacuole with its osmiophile membrane, d approaching diastole, and s at systole. (b) Osmiophile ring around contractile vacuole of *Dogielella*, at diastole. (c) Ring-shaped Golgi apparatus in epidermal cell of Axolotl larva.

After Nasonov.

not know. This point, which is of considerable importance, should be cleared up as soon as possible, as, so far as we know, Golgi bodies never appear *de novo* after cell division.

Howland (1924), experimenting with *Amœba verrucosa*, succeeded in demonstrating a membrane, stainable in neutral red, around the contractile vacuole. She also determined, as Nasonov has done, that this membrane was not itself contractile, but collapsed in folds at systole. This author

claims to have isolated the vacuole, and states that it preserves its identity for an indefinite period free in water. This does not agree with the conception of the excretory apparatus as a semi-permeable membrane containing an osmotically active substance. If such an apparatus were set free in water, it would burst. Since a distinct complete membrane has been demonstrated, it is evident that the contractile vacuole of *Amoeba* conforms to the type described by Nasonov for *Infusoria peritricha*, but the reactions determining the working of the vacuole must be more complicated than is supposed by Nasonov, if Howland's results can be confirmed.

Sokolska (1927) homologises the osmiophile loop or band applied to the pyriform bodies in the endoplasm of *Opalina* with the ring of Dogielella; she applies Nasonov's term, "bound secretion," to the pyriform body itself, while in connection with the band, and later, when the latter separates off, as it often does, the former is referred to as "free secretion." This interpretation rests on a misconception of Nasonov's terms; the pyriform body is at no stage actually in the interior of the chromophil band. The latter is merely applied to the former, recalling to mind the chromophil and chromophobe parts of the Golgi apparatus, with this difference, that in *Opalina* the band can break away entirely from the pyriform body and lie free in the cytoplasm. By Sokolska's interpretation we would regard this band as the true Golgi element, and the pyriform body as merely a secretory product of the latter. The definite relations (which Sokolska has not observed) existing between these bodies and the basal granules of the cilia negative the idea that they are merely a transitory secretory product. Possibly, when the chromophil band breaks away, it may be accompanied by a small amount of chromophobe matter, and we can interpret the process as a multiplication by fission of the Golgi elements, but without further work we cannot be certain of its exact significance.

The hypotheses of Nasonov and Grassé are both very attractive, and both seem to be supported by a great deal of weighty evidence. Until further work has been done substantiating their results, we cannot regard either of them as proved. For instance, the case of flagellates such as the free-living *Bodo*s and the Euglenoids, in which both parabasals and contractile vacuoles are present, should be investigated, and further work on the parasitic ciliates is urgently needed. Until such work has been done, we can only say that a normal Golgi apparatus is present in the sporozoa, and that the whole question of the nature of the Golgi bodies in the other protozoan classes is still under discussion.

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

STAINING AND IMPREGNATION METHODS.

Phloxine.—C. J. CHAMBERLAIN (*Stain Technol.*, 1927, 2, 91–93). A double stain with Magdala red and anilin blue gives variable results, due to the fact that many stains sold under the name of Magdala red do not contain any of this substance. The standardized stain phloxine seems to be identical with successful lots of Magdala red, and results are uniformly successful. G. M. F.

Vital Neutral Red.—M. PHILLIPS and B. COHN (*Stain Technol.*, 1927, 2, 74–79). Neutral red iodide suitable for vital staining was prepared by condensing nitrosodimethylanilin hydrochloride with *m*-toluylenediamine, and the indamine toluylene blue was obtained. This was subjected to air oxidation and converted to the eurhodine, neutral red. The purification of this dye was brought about by converting it into its comparatively insoluble stannous chloride double salt, filtering, dissolving in water and precipitating the neutral red iodide with potassium iodide solution. This was re-dissolved in water, re-precipitated with potassium iodide solution and crystallized from 95 p.c. ethanol. The uncrystallized dye was also found satisfactory for vital staining. Satisfactory stains were obtained only when the preparation was free from toluylene blue. The chloride of the colour base was prepared by continuing the air oxidation of the toluylene blue until a test sample indicated its complete conversion into neutral red. The colour was salted out with sodium chloride and crystallized from 95 p.c. ethanol. Both the crystallized and uncrystallized products are excellent stains. G. M. F.

Staining Nuclei in Uncut Material by Means of the Nucleal Reaction.—H. VOSS ("Kernfärbung im Stück mit der Nuclealreaktion," *Zeitschr. Wiss. Mikrosk.*, 1926, 43, 115–116). The nucleal reaction described and used by Feulgen and Rossenbeck for microtome sections can also be used for uncut material, but staining proceeds more slowly. The material is fixed preferably in sublimate or sublimate acetic acid. The reagents are prepared according to directions previously given by Feulgen and Rossenbeck. *Biological Abstracts.*

Subsidiary Dyes in Methylene Blue.—W. C. HOLMES (*Stain Technol.*, 1927, 2, 71–73). Tests are described for the detection of azure B (trimethyl thionin) and methylene violet in methylene blue. All samples of methylene blue examined have been found to contain appreciable proportions of azure B. G. M. F.

Stain Solubilities, Part II.—W. C. HOLMES (*Stain Technol.*, 1927, 2, 68–70). Data are given to show the unreliability of statements as to the solubility of any dye unless the dye tested is known to have been free from inorganic salts. A table is given showing the solubility in water and in alcohol of 23 different dyes.

G. M. F.

Vital Staining in Gregarines, and the Sexual Characteristics of Cytoplasm.—Ph. JOYET-LAVERGNE (*C.r. de l'Acad. des Sc.*, 1926, 7, 1295-1297). By vital staining with neutral red, methyl blue, Nile blue, etc., there are found to be two types of individuals in *G. polymorpha* and *G. cuneata*. *Stenina ovalis* also shows this differentiation in staining. In syzygy the primate ♀ is always more strongly coloured than the satellite ♂. This is interesting to note, as it points to a sexualization of cytoplasm. Mühl uses these differences as a proof of variations in the acidity of protoplasm. This theory is rejected by Joyet-Lavergne.

A. G. H.

A Rapid Method of Examining Tissue Microscopically for Malignancy.—B. T. TERRY (*J. Path. and Bact.*, 1927, 30, 573-574). This method is applicable to fresh unfixed material and allows the preparation of a section for microscopic examination in less than 60 seconds. The tissue is immobilized by pinning it securely to a cork board. With a very sharp razor blade, wet with water, a thin plane parallel slice is cut, washed in water, drained and placed on one end of a glass slide. On the other end a small drop of neutralized polychrome-methylene blue is spread out. An edge of the slice of tissue is grasped with sharp-pointed forceps, raised slightly, and the tissue is drawn over on top of the stain, where it is moved about for 2 to 4 seconds, care being taken not to get any stain on the upper surface. The section is immediately washed in water gently but thoroughly, is drained and then mounted on a slide, stained side up, beneath a cover glass. It should be examined at once by transmitted light. A 60-watt frosted Mazda bulb close to the mirror of the microscope is an excellent source of light. Directions are given for the preparations of the polychrome-methylene blue.

G. M. F.

GENERAL CYTOLOGY

Electrical Conductivity of Protoplasm.—S. GELFAN ("The Electrical Conductivity of Protoplasm and a New Method of its Determination," *Univ. California Publ.*, 1927, 29, 453-465, 2 text-figs.). A method is described whereby the electrical conductivity of protoplasm can be directly measured by penetration into the interior of the cell by non-polarizable micro-electrodes. The internal conductivity decreases with injury. It is possible that the concentration of dissociated molecules in the protoplasm is in some way related to the activity of the organism.

G. M. F.

Gamma Irradiation and Cell Division.—R. G. CANTI and F. G. SPEAR ("The Effect of Gamma Irradiation on Cell Division in Tissue Culture *in vitro*," *Proc. Roy. Soc.* 1927, Series B, 102, 92-101, 4 text-figs.). Gamma radiation has a definite effect in reducing the number of cells in mitosis in tissue cultures *in vitro*. This effect is not demonstrable until the culture has been subjected to irradiation for a period of time which is greater with a smaller intensity of irradiation. When this threshold is passed, the effect upon mitosis is sudden and well marked. No evidence is seen of any stimulating effect of gamma rays on cell division under the experimental conditions. The action of radium is not purely cumulative, and there is a minimum threshold of intensity below which a given biological effect will not take place however long the time of exposure.

G. M. F.

Cell-Division.—J. GRAY ("The Mechanism of Cell-Division:—III. The Relationship between Cell-Division and Growth in Segmenting Eggs," *Brit. J. Exp. Biol.*, 1927, 4, 313-321). Successive cleavages of the egg of *Echinus miliaris* are separated by equal intervals of time. The time required for the complete cleavage cycle is independent of the size of the cell. The rate of cell-division bears no

obvious relationship to the rate of metabolism. Cell-division and growth are the factors which determine the size of individual cells. In some cases these factors may establish a well-defined equilibrium, but in segmenting eggs they are probably quite independent of each other. G. M. F.

The Nature of "Golgi Bodies."—C. E. WALKER and MARGARET ALLEN ("On the Nature of 'Golgi Bodies' in Fixed Material." *Proc. Roy. Soc.*, 1927, B. 101, 468). It is argued that the Golgi elements and apparatus are probably artifacts produced by the methods used to demonstrate them. The addition to certain colloidal mixtures of lecithin and kephelin makes it possible to stain up structures in the colloids after fixation without acetic acid which are very similar to Golgi bodies. If acetic acid is used in fixation of these colloids, the structures do not appear, probably because lecithin and kephelin are broken up by acetic acid. This is comparable with what is found in the fixation of tissues. Golgi bodies do not appear in microscopic preparations if acetic acid is used in the fixative. From this comparison it is argued that the use of acetic acid breaks up the substances in the cell which are necessary for the production of "Golgi bodies" with osmic acid. A. S. P.

Hepatic Mitochondria in Anaphylactic Shock.—J. F. MARTIN and P. CROIZAT ("La foie dans les chocs et les réactions anaphylactiques," *J. de Méd. de Lyon*, 1927, 361-369, 7 text-figs.). Anaphylactic shock, if at all prolonged, produces chondriolysis in the hepatic cells immediately surrounding the portal vein. The mitochondria in the outer portion of the lobule remain intact. G. M. F.

Mitochondria in *Nyctotherus cordiformis*.—E. S. HORNING ("Mitochondrial Behaviour during the Life-Cycle of *Nyctotherus cordiformis*," *Austral. J. Exp. Biol. & Med. Sci.* 1927, 4, 69-74, 1 pl.). Mitochondria are present in *Nyctotherus* during all stages of the life-cycle; they increase by transverse binary fission at irregular intervals during the life-history of the organism, and there is no relation between nuclear division and fission of mitochondria. Mitochondria are found within the food vacuoles of *Nyctotherus*. G. M. F.

Mitochondria and the Nucleus.—E. S. HORNING ("On the Relation of Mitochondria to the Nucleus," *Austral. J. Exp. Biol. and Med. Sci.*, 1927, 4, 75-78, 1 pl.). Observations show that mitochondria are not traceable through the nuclear membrane in the epithelial cells of the submaxillary gland, as has been stated by R. Honda (*Anat. Rec.* 1927, 34, 301). Dense aggregations of mitochondria about the outer surface of the nucleus, such as are seen in many cells, are probably a surface tension phenomenon connected with the phosphatid nature of the mitochondria. G. M. F.

Appearance of Chromosome Vesicles in Meiosis of Some Acrididæ.—M. EISENTRAUT ("Über das Auftreten von Chromosomenbläschen in den Reifeteilungen einiger Acridier," *Zeitschr. Wiss. Zool.*, 1926, 128, 253-266, 1 pl. 3 text-figs.). This paper extends the author's work on the spermatogonia of *Oedipoda coerulescens* and *Gomphocerus maculatus* to the maturation stages. The point of especial interest is the enclosing of each chromosome in a separate vesicle during the late prophase of the first maturation division. These vesicles persist until spermatid formation. It is suggested that this isolation in vesicles may indicate chemical differences associated with quantitative differences. Observations support the belief that the nuclear membrane is derived from chromosome vesicles. There is no common nuclear membrane in these cells.

Morphology and Biology of *Rickettsia melophagi*.—L. ANIGSTEIN ("Untersuchungen über die Morphologie und Biologie der *Rickettsia melophagi* Nöller," *Arch. Protistenk*, 1927, 57, 209–246, 4 pl.). In a histological and cytological examination of the intestinal epithelium of *Melophagus ovinus* it developed that distribution and arrangement of the Rickettsias depends on the structure of the epithelium. The latter also seems to play a functional rôle, in that colonization of the external Rickettsias is counteracted on the secretory parts. In the secretory intestinal epithelium organisms are assembled which are probably intracellular Rickettsias and are entirely independent of the mitochondria. Confirming Nöller and Kuchling, the author cultured *R. melophagi* not only from the intestine of *M. ovinus*, but also from the blood of sheep; five strains were isolated. The morphological properties of these strains conformed to those found *in vivo* in *M. ovinus* and were similar to other described Rickettsias. The cultural variability of *R. melophagi* was about as described for other forms. In growth and microscopical characters the typhus fever strains are very similar to *R. melophagi*. Serologically the cultures from *M. ovinus* are related to those of typhus fever and *Corynebacterium*, and the author would place them next to *Corynebacterium*. The Rickettsia is a very pleomorphic and easily adaptable organism, showing differences in size and biological properties depending on nutrition. The so-called "Rickettsia-type" is only one stage of the Rickettsia, and should not be considered a stage in the development of other unrelated organisms. The anatomy of the gut of *M. ovinus* is briefly described. The author gives methods for culturing the organism and preparing antigens for the production of an immune serum for agglutination studies. The various forms of *R. melophagi* are discussed, with figures showing relation to the intestinal epithelium of the tick.

Biological Abstracts.

Tissue Culture of Human Blood Cells.—E. VERATTI ("Culture alla Carrel di sangue umano," *Rendiconti Reale Istit. Lombard.*, 1927, 60, 308–317, 4 text-figs.). In primary cultures of human blood of a case of leukæmia there are found non-granular mononuclear elements of varying form. The granular leucocytes and lymphocytes, after a longer or shorter period, undergo necrosis, so that in the second subculture there are only mononuclear leucocytes. There is no true fibroblast formed.

G. M. F.

Vital Dyes and *Paramecium*.—G. H. BALL ("Studies on *Paramecium*. III. The Effects of Vital Dyes on *Paramecium caudatum*," *Biol. Bull.*, 1927, 52, 68–78). The only dyes staining the cytoplasm of normal living *Paramecium* belonged to the basic group. Those found to be most suitable were bismark brown, methylene blue, methylene green, neutral red and toluidin blue. The cytoplasm of normal animals could not be stained by any of the acid dyes used, although these might stain the contents of the food vacuoles or the cytoplasm of dead or dying *Paramecium*. The presence of dye in the food vacuoles was not necessarily fatal to *Paramecium*, but animals with stained cytoplasm could not live in solutions of the dye indefinitely except in dilute solutions of bismark brown. The exposure to light of *Paramecium*, having the cytoplasm stained by certain dyes or in a concentrated solution of eosin, produced a marked avoiding reaction within five seconds. The animals giving this reaction died much more rapidly in strong light than in darkness.

G. M. F.

Neuromotor Apparatus of *Boveria teredinidi* (Nelson).—E. A. PICKARD ("The Neuromotor Apparatus of *Boveria teredinidi* (Nelson), a ciliate from the gills of *Teredo navalis*," *Univ. California Publ.*, 1927, 29, 405–428, 1 pl.).

Boveria teredinidi (Nelson) is characterized by an adoral spiral which forms a dextrotropic whorl of one and a quarter turns continued as a short leiotropic whorl distally; eighteen to twenty-two rows of lateral cilia attached by basal granules to longitudinal myonemes; oral and adoral cilia from one-third to one-fifth the body length. A consideration of all the characteristics of *Boveria* shows a closer relationship to the Heterotrichida than to the Holotrichida. A new family, Boveridae fam. nov., is proposed for this group of ciliates under the Heterotrichida. The neuromotor system consists of a neuromotorium from which fibres pass to the different regions of contractile activity. These fibres consist of (1) an oral ring surrounding the cytostome which gives rise to a branch of the pharyngeal fibre. (2) A posterior adoral fibre running from the neuromotorium connecting the posterior adoral cilia. (3) A second fibre, the anterior adoral fibre. (4) The pharyngeal fibre. The lateral co-ordinating system consists of longitudinal myonemes with their basal granules and cilia and a deeper peripheral network of interstitial connectives and commissural fibres. The substance of the neuromotor apparatus of the protozoa seems similar to the nerve tissues of the metazoa, since both are demonstrated by Da Fano's silver-gold stain. G. M. F.

A. VERTEBRATA.

Embryology, Evolution, Heredity, etc.

Biological Classification: Past and Future.—F. A. BATHER (*Quart. J. Geol. Sci.*, 1927, 83 pt.). In this presidential address Dr. Bather reviews the various kinds of classification with much valuable historical detail, shows the vital importance of evolutionary theory in this respect, and stresses the long delay which occurred before systematists took advantage of it. Yet even phylogenetic biology may be mishandled. "To discover phylogeny is not, as has been claimed, the supreme goal of the biologist. It is more important to discover the laws of phylogenesis, which, philosophically and practically, are supreme laws of life." Biologists generally will be glad to have their attention directed to this masterly summary of facts and arguments bearing upon classification. E. W. B.

Growth of Foetal Mice.—E. C. MACDOWELL and E. ALLEN ("Weight of Mouse Embryos 10-18 days after Conception, a Logarithmic Function of Embryo Age," *Proc. Soc. Exp. Biol. Med.*, 1927, 24, 672). From 10 days p.c. to 18 days p.c. the weight of the mouse embryo is a logarithmic function of its age, if the embryo age is given as seven days less than the conception age. The equation for this curve is the power function of the form, $W = Kt^n$, in which W is the weight, t the age, n the slope of the graph on double logarithmic paper, and K the intercept on the W axis—that is, the weight at the end of the first day. The constants obtained when substituted in this equation in logarithmic form give: $\log W = 3.656 \log (t-7) + \log .000188$. A. S. P.

Anovular Follicles.—Y. TAMURA ("On Anovular Follicles in the Ovaries of the Sterile Dingo and the Aged Mouse," *Journ. Anat.*, 1927, 61, 325). Anovular follicles are described in adult sterile dingo bitches and in old mice which had had more than six litters. In the case of the dingos many primordial follicles were found, the ovum of which showed degeneration in most cases. The anovular follicles varied in size very considerably, from .069 mm. to .19 mm. in diameter. The condition of the anovular follicles suggested that the ovum had been absorbed and the membrana granulosa preserved when the follicle was of the size exhibited

at the time of examination. As regards the cause of the anovular follicles which are frequently found in old, sterile, or pregnant individuals, it is suggested by the author that they are of nutritional origin, and that when the hypothetical "generative ferment" is inadequate, many of the follicles of the ovary fail to proceed to their normal development and become anovular.

A. S. P.

Development of the Clydesdale Horse.—A. CALDER ("The Rôle of Inbreeding in the Development of the Clydesdale Breed of Horses," *Proc. Roy. Soc. Edin.*, 1927, 47, 118-140). Coefficients of inbreeding, calculated for 676 stallions and mares, show that in the early history of the breed very little inbreeding was practised, probably owing to the presence of many undesirable recessive characteristics in the foundation stock. Since 1880 to 1890, when the first noticeable rise in the inbreeding coefficient occurred, a gradual but constant increase has been maintained, reaching its highest point of 6.25 p.c. (Wright's coefficient) for the last quinquennial period. Extending the coefficient system to measure the contribution of any particular sire to the average percentage of inbreeding for the breed, it was found that Darnley made the greatest contribution up to about 1912, and subsequently Baron's Pride has been the chief contributor. Analysis suggests that Darnley was popular among Clydesdale breeders in general, while other stallions have had a more restricted popularity. The coefficient for inbreeding for mares rises above that for the stallions only during the period 1885-1895. The homozygosity for the Clydesdale breed has been increased by 6.2 p.c. by inbreeding alone.

A. S. P.

The Ovarian Grafts in the Mouse.—Y. TAMURA ("The Effects of Implantation upon Ovarian Grafts in the Male Mouse," *Proc. Roy. Soc., Edin.*, 1927, 47, 148-164, 2 pls.). Male mice which had received grafts of ovary into the kidney, were killed at periods varying from 10 to 35 days after operation. In the majority of cases the graft had retained its typical ovarian structure. In one instance only, however, were corpora lutea present. The survival of the graft is apparently dependent, firstly upon its vascularization, and secondly upon the degree of activity of the germinal epithelium. Where the germinal epithelium has not been damaged, it continues to proliferate, and ovarian tissue of the normal type is produced. The original follicles begin to degenerate soon after transplantation, the rate of degeneration being inversely proportional to the size of the follicle. The interstitial tissue of the graft appears to be derived from the follicular cells of the small-sized anovular follicles. The presence of the testis does not appear to affect the vitality of the ovarian graft.

A. S. P.

Sex-Transformation in Cattle.—A. CALDER ("A Case of Partial Sex-Transformation in Cattle," *Proc. Roy. Soc. Edin.*, 1927, 47, 222). A case of sex-transformation in a pedigree Aberdeen Angus cow is described. As a yearling and a two-year-old she won several prizes as a heifer, and subsequently she became pregnant and produced a calf. After one more pregnancy and an irregular occurrence of the oestrous cycle for two years, the assumption of male secondary sexual characters became apparent, the change in behaviour being discernible before changes in conformation were seen. On post-mortem examination it was found that both ovaries were in an advanced stage of cystic degeneration. No corpora lutea were present, and it appeared that the cysts had arisen in follicles which had failed to rupture. The uterus and uterine horns were hard to the touch and acutely inflamed. The other endocrine organs appeared to be quite normal.

A. S. P.

Male Plumage in Laying Fowl.—F. A. E. CREW ("Studies on the Relation of Gonadic Structure to Plumage Characterization in the Domestic Fowl. III. The Laying Hen with Cock's Plumage," *Proc. Roy. Soc.*, 1927, B. **101**, 514–518, 1 pl.). Many instances have been recorded from time to time of female fowl which, though laying normally, showed development of male plumage. The explanation of these cases appears to be that immediately following the moult, the ovary becomes inactive and a condition of physiological ovariectomy results, which causes the development of the male plumage as would follow operative ovariectomy. The inactivity of the ovary, however, is purely temporary, and subsequently normal activity, including ovulation, is found. Since the plumage remains male until the next moult, the seemingly anomalous combination of egg-laying and male plumage is brought about.
A. S. P.

Sex-Intergrades in Foetal Pigs.—W. HUGHES (*Biol. Bull.*, 1927, **52**, 121–136, 4 pls.). A considerable number of sex-intergrades in adult swine have been described. The free-martin condition as a possible explanation has been discussed and abandoned partly on the grounds that chorionic fusions with their complications have not been described in the pigs. In three cases described, typical sterile free-martins would have developed. The gonads might be structural testes or possibly ovo-testes.
G. M. F.

Artificial Cryptorchidism.—J. T. CUNNINGHAM ("Experiments on Artificial Cryptorchidism and Ligation of the Vas deferens in Mammals," *Brit. J. Exp. Biol.*, 1927, **4**, 333–341, 2 text-figs.). Observations are recorded showing that the temperature of the scrotal cavity is lower than that within the abdomen. If the testis is displaced from the scrotal cavity to the abdominal cavity, after three weeks the seminal tubules are found to be reduced in size and their contents degenerate with no spermatogenesis, while the interstitial tissue is relatively increased. After ligation of the vas deferens the contents of the seminal tubules showed normal spermatogenesis.
G. M. F.

Ovarian Hormone and Development of the Uterus Mammæ.—C. CHAMPY and T. KELLER ("Développement utérin et mammaire par injection d'hormone ovarienne," *Compt. rend. de l'Acad. des Sc.*, 1927, **185**, 302–304). The injection of a lipid extract of the corpus luteum or placenta in female castrated guinea-pigs causes conditions in the uterus and vagina simulating those produced by pregnancy. The mammary gland also attains a size akin to that of pregnancy. Injection of a similar extract in males causes no change in the genital tract, but a change in the male mammary glands quite as pronounced as that in the female.
G. M. F.

Histology.

Neurone Functions in Sympathetic Ganglia.—O. W. TIEGS ("The Structure of the Neurone Junctions in Sympathetic Ganglia and in the Ganglia of Auerbach's Plexus," *Austral. J. Exp. Biol. and Med. Sc.*, 1927, **4**, 79–98, 3 pls.). By the use of the methylene blue and reduced silver methods, using material from the cat, rabbit, guinea-pig, calf, frog, and man, it is observed that (except in the frog) the predominant type of ending is the same as that revealed in the spinal cord cells, i.e., the axon collaterals penetrate either into the body of the nerve cell or, more commonly, into its dendrites. They pass as neurofibrils towards the centre of the cell, where they anastomose; this anastomosing network appears to be the seat of the integration. In addition there occurs also a second type of ending, in the form of a pericellular ramification of nerve fibres, closely enveloping

the body of the cell. This is the only kind found in the frog's sympathetic trunk. The end ramification lies beneath the cell capsule, but it is not possible to state whether it penetrates into the protoplasm of the cell or whether it ends in close contact with the cell surface. It is pointed out that a discontinuity of the staining reaction (as seen in Golgi and methylene blue preparations) constitutes no argument for discontinuity in the neurone junction; while, on the other hand, analogy with the motor ending of skeletal muscle is strong evidence in favour of protoplasmic continuity at the junction. It is pointed out that, though the actual growth of axon collaterals into the dendrites constitutes the predominant type of neurone junction, it is only in rare cases that this may be directly observed. Human sympathetic ganglia have been specially investigated, and it is concluded that the many remarkable cases of neurone discontinuity figured by Cajal are due to his failure to recognize the dendrite terminations as artefacts, due to their emergence from the plane of the section. In the ganglia of a senescent, but not of a young human subject, the axons and dendrites may degenerate into large globules. Thus is brought about a gradual disruption of the nerve connections within the senescent ganglion.

G. M. F.

The Suprarenal Cortex and Testis in the Rat.—A. WATSON ("The Relationship of the Cortex suprarenalis and Testes Throughout Life in the Rat," *Brit. J. Exp. Biol.*, 1927, 4, 342-348, 1 pl., 1 text-fig.). While in the mole, with a well-marked oestrous cycle, correlated changes occur in the cortex suprarenalis and in the interstitial cells of the testes, in the rat no change was found in the breadth or in the lipid content of the cortex throughout the year. The lipoids were evenly distributed throughout the cortex in the embryo, but from the age of two weeks onwards a lipid free zone was present between the fasciculata and glomerulosa. The interstitial cells were proportionately more abundant in early life than in sexual maturity and old age. Lipoids were present in the interstitial cells of the embryo and up to two weeks of life, after which age they were absent. In this respect the rat differs from the human subject, where the onset of puberty is accompanied by an increase in interstitial cells and the presence of lipoids in and around them. From the twelfth week lipoids appear between the cells lining the tubules of the testes; these lipoids are most abundant in the tubules where spermatogenesis is at an early stage. The cortical cells of the adrenal are regarded as playing an ancillary part to the interstitial cells of the testes.

G. M. F.

The Distribution of the Lymphatics.—J. LORRAIN SMITH and T. RETTIE ("The Distribution of Lymphatics Defined by Fatty Acid Compounds Developed in the Autolysis of Their Contents," *Proc. Roy. Soc., Series B.*, 1927, 102, 102-109, 1 pl.). A method of demonstrating the anatomical form and derangement of the lymphatics of the liver by observing post-mortem autolytic changes in the lymph. Autolysis of the lipid contained in this lymph forms doubly refractile globules of "soap" often in such quantity that the lumen of the channel is filled continuously. Lymphatics of the liver are defined because in them the globules form abundantly and at a stage when, as yet, no sign of them is to be found in any other site. The portal lymphatics of the guinea-pig's liver afford the best demonstration of lipid autolysis in lymph.

G. M. F.

Grafting the Eye.—R. MATTHEY ("La greffe de l'œil. Étude expérimentale de la greffe de l'œil chez le Triton," *Archiv. f. Entwicklungsmech. der Organismen*, 1927, 109, 326-341, 5 text-figs.). In the salamander larva the examination of an autografted eye forty days after operation shows a complete histological re-establishment—the retina is normal, the optic nerve has regenerated and has reformed

its connections with the brain. Success is equally possible if the graft is made on the summit of the cranium, provided that mechanical obstacles do not interfere with the regeneration of the optic nerve. In the adult triton the intracranial section of the optic nerves and their junction after one to two minutes is followed by regeneration of the nerve and the re-establishment of normal vision. Homografts give identical though less constant results, since in addition to re-establishing its nervous connections with the brain, the influences of attacking a foreign body have also to be resisted.

G. M. F.

Anatomy of *Phreatobius cisternarum* Goeldi.—MANFRED REICHEL ("Étude anatomique du *Phreatobius cisternarum*, Goeldi, silure aveugle du Brésil," *Rev. Suisse de Zool.*, 1927, **34**, 285–404, 4 pls. and 15 text-figs.). It is impossible to abstract or summarize this paper, but it is worthy of notice as being the first detailed study of this blind Brazilian fish first found by Goeldi, and of which no other examples have been reported save the six inhabitants of the cistern where the original specimen was obtained. There is included a histological account of the degenerated eye and a study of the very interesting sensory organs, and a discussion of the fish's systematic position.

J. F. C. H.

The Rôle of the Skeleton in Regeneration.—V. BISCHLER ("L'influence du squelette dans la régénération, et les potentialités des divers territoires du membre chez *Triton cristatus*," *Rev. Suisse de Zool.*, 1926, **33**, 431–561, 3 pls. and 25 text-figs.). Experimental evidence is brought forward to show that the bone does not play any part in the determination of the morphology of the regenerated limb, nor does it give rise to new skeletal elements. Each segment only possesses the capacity to regenerate the skeletal parts of the segments situated more distally to it. Different areas of a limb have varying powers of regeneration which are specific for those areas.

G. M. F.

Regeneration in Urodela.—E. GUYÉNOT ("Le problème morphogénétique dans la régénération des Urodèles : détermination et potentialités des régénérats," *Rev. Suisse de Zool.*, 1927, **34**, 127–154, 10 text-figs.). A review of the present state of knowledge on regeneration in batrachians. Portions of regenerating tissue when transplanted to other regions have no regenerative power apart from the basal region on which they are fixed. Thus the base of a foot causes the development of a foot in regenerating tissue derived from the tail. The base of a tail always induces a tail, while the region of the back produces no further differentiation in regenerating tissue. Regeneration is thus a specific characteristic of certain regions or territories of the organism. This idea of specific territories is shown by diverting the nerves of a foot to the region of the shoulder girdle or region of the pelvis, when a limb develops. If, however, the nerves are diverted to the dorsal crest or tail, a local hypertrophic growth or a small tail is produced. These facts show that nerves act solely as excitants to growth, each territory reacting to the excitation according to its own potentiality. If the whole of one territory is removed, e.g. the caudal area, there is then no regeneration of the tail.

G. M. F.

Loss of Regenerative Power in Anura.—E. GUYÉNOT ("La perte du pouvoir régénérateur des Anoures, étudiée par les hétérogreffes et la notion des territoires," *Rev. Suisse de Zool.*, 1927, **34**, 1–53, 1 pl. and 21 text-figs.). The feet of *Bufo vulgaris* removed at a time when they do not regenerate normally have continued to show no regeneration, although they have been transplanted on to the larvæ of *Salamandra maculosa*, which undoubtedly form a medium favourable to progressive regeneration.

G. M. F.

INVERTEBRATA.

Mollusca.

A New Snail from Holland.—A. L. J. SUNIER (" *Vertigo substriata* Jeffreys, faunæ neerlandicæ n.sp., een zoogenaamd glaciaalrelikt (with French résumé), *Zool. Mededeel.* 1926, 9, 113–178). A study of a small snail (Pupillidæ) new to the fauna of Holland. The species is one of great uniformity, varying little from type; tables give dimensions of specimens from Holland and Sweden, those from the former being longer. The species in Holland is probably a glacial relict, occupying certain isolated places which were not glaciated during the latter part of the Pleistocene. This species is typically arctic and alpine in its present distribution, and such has doubtless been its habitat conditions during Pleistocene and earlier geological time. *Biological Abstracts.*

Marine Mollusca from India and Ceylon. (I) Dentalium.—R. WINCKWORTH (*Proc. Malac. Soc.*, 1927, 17, 167–169, 1 pl., 1 text-fig.). Descriptions of two new species, with accounts of the anatomy and radula (*D. mannarensis* and *D. elpis*). The radulae in this genus are very much alike. E. W. B.

Revision of the Ampullariidæ of Jamaica and Cuba.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1927, 79, 247–253, 2 pls.). The generic name *Ampullaria* is used because it will be generally understood. The type of that genus, however, was an oriental species with a calcareous operculum. *A. fasciata* Roissy is allowed to stand: Lamarck used the name for another species some years later. A new species, *A. pæyana*, is differentiated from the South American *A. glauca*. All the species are figured. E. W. B.

On Some North American Vaginulidæ.—H. HOFFMANN (*Proc. Acad. N.S. Phila.*, 1927, 79, 209–221, 5 text-figs.). Comments upon H. B. Baker's paper on the group, under the name Veronicellidæ. Figures are given of the genitalia of *Leidyula schioelyæ* and *L. floridana*. Author protests against the statement that his figures are highly idealised. E. W. B.

Minute Mexican Land Snails.—H. B. BAKER (*Proc. Acad. N.S. Phila.*, 1927, 79, 223–246, 6 pls. (57 figures)). These small forms are referred to Pupillidæ, Endodontidæ, Sagdidiæ and Helicidæ. The figures are of great interest in connection with the family grouping, and the whole paper is indispensable to students of these small forms. We are told that serial sections were made from material fixed in the field with B_3 plus chromic acid. Alum cochineal and Orange G were used as stains. (The meaning of B_3 is obscure; in all such cases it would be more helpful to give the actual formula. If we desire to glorify the inventor, his name can easily be included in a reference.) E. W. B.

The Structure and Affinities of Humboldtiana and Related Helicid Genera of Mexico and Texas.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1927, 79, 165–192, 14 text-figs., 4 pls.). This paper deals with forms allied to the larger Helices of this country. It is illustrated not only by outline figures, but also by numerous excellent photographic plates. *Humboldtiana* has four mucous glands "concrecent into a ring adnate upon the vagina" (the photographs show this well), and four dart sacs. *Lysinae* has three mucous glands and two dart sacs; *Leptarionta* a pair of mucous glands and a dart sac; while *Tryonigens* has neither, and also lacks a flagellum. The radulae are all of ordinary Helicid types. Pilsbry includes in *Humboldtiana* a species in which the jaw has evanescent ribs; the five

forms figured include the principal modifications of this organ which occur in the Helicidae. Pilsbry regards the abbreviation of typical structures in these molluscs as degenerative. It may be noted that meanwhile the radula supplies the clue to their real position.

E. W. B.

Some American Land and Freshwater Mollusks ; Notes and Descriptions.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1926, 78, 1-15, 2 pls., 4 text-figs.). This paper includes figures of the radula of *Temesa incarum* and of two very dissimilar species of *Nenia*.

E. W. B.

Structural and Functional Changes Produced in the Gastropod Mollusk *Physa occidentalis* in the Case of Parasitism by the Larvæ of *Echinostoma revolutum*.—F. C. T. HURST (*Univ. Calif. Publ. (Zool.)*, 1927, 29, 321-404, 4 pls.). Of 550 specimens from the same locality, 83.6 per cent. contained parasites. Other observations on this point are quoted. Parasitised snails are lighter in colour and often show a peculiar unnatural orange colour in the region of the viscera. Reduction of the host's pigment and production of that of the parasite account for these changes. There is some indication that snails may sometimes recover from the parasitised condition. The degree of infection is not uniform. The parasites in the multiplicative phases are in the sinuses of the connective tissue, particularly in the hepatopancreas in the case of active larvæ. Encysted flukes may be found in any tissue. The presence of parasites causes reduction of the muscular tissue of the foot and the lowering of its glycogen content ; Amœbocytes are largely suppressed ; more concretions occur in the kidney ; the Golgi bodies in the buccal epithelium are increased in size and number, while the reverse occurs in the intestine. Fibromata occur in the connective tissue of the liver, the gonad is reduced or destroyed. Observations were also made on the physiological chemistry of the condition.

E. W. B.

Hibernation and Aestivation in Gastropod Molluscs.—S. L. HORA and H. S. RAO (*Records of Indian Museum*, 1927, 29, 49-62, 10 text-figs.). Twice during the year (October to December and February to June) conditions become unfavourable, and the snails retire into their shells and seal up the entry with an epiphragm. As many as five successive epiphragms may be secreted, one inside another. The authors have examined their consistency. On removing the epiphragm from a hibernating snail by immersing it in water, the snail can be made to crawl out ; but generally, even when fed upon suitable food, it will again retire and secrete another covering. If this is done repeatedly, the consistency of the membrane becomes thinner and less effective. The jaw and radular teeth of *Succinea crassinuclea* Pfr., one of the species examined, are figured ; the observation is made that the amphibious *S. indica* Pfr. occurs in larger numbers.

E. W. B.

On the Effects of Overcrowding on the Growth of the Water Snails *Limnæa pereger* and *L. stagnalis*.—F. M. TURNER (*Essex Naturalist*, 1927, 22, 48-56, 2 pls.) Jabez Hogg (*Trans. Micros. Soc.*, 1854, 2, 91) states that new-born *L. stagnalis* kept in water alone without weed attain only a small size, but remain alive. He kept them thus for six months, while others of the same brood under favourable conditions reached maturity. Dr. Turner experimented on similar lines, though his results are not exactly the same as those recorded by Hogg. He finds that the specimens with retarded growth are not true dwarfs, for the small snails grow up normally when removed from the unpropitious surroundings. A similar retardation may occur in Nature, just as it does with plant seedlings which have been sown too closely. Similarly also in a given dense population some

individuals will outgrow the others and usually a few will fall considerably below the average. Semper (1874, see also his "Animal Life," in Int. Sci. Series) grew snails in jars of different sizes, and varying numbers in jars of uniform size. He found rate of growth to be proportional to the size of the jar. "Five observers have carried out investigations on this point, and all except the last agree substantially with Semper as to the facts, but all favour different theories as to the explanation." Till the snail is half grown, increase goes on in geometrical progression; afterwards it falls off. It is inferred from Semper's work that snails ultimately reach a limiting size corresponding to the size of the jar. This the author has approximately verified. He also finds that in a series of jars of the same size, but with populations of different sizes, growth of snails is inversely proportional to their number (Semper). Semper's explanation is that some unknown chemical is present in the water in definite quantity only, and gets used up when too many snails are present. That it is not due to lack of oxygen or excess of carbon dioxide is shown by Varigny's experiment. Popovici found that "adequate" feeding caused increase of the size of the snails irrespective of the size of the jar. The adequate food used was lettuce leaves; Turner confirms this rather surprising result. These snails do not eat Elodea, only the algæ which grow upon it. The dwarfing induced by the experiments is much greater in degree than in land animals, but the effect is only temporary. These *Limnaea* are extremely resistant to foul surroundings.

E. W. B.

Arthropoda.

Insecta.

Gynandromorphs in *Habrobracon*.—P. W. WHITING and A. R. WHITING ("Gynandromorphs and Other Irregular Types in *Habrobracon*," *Biol. Bull.*, 1927, 52, 89–120, 2 pls. and 8 text-figs.). In a stock of *Habrobracon juglandis* (Ashmead) there occurred both intersexes and gynandromorphs. The fundamental distinction between intersexes and gynandromorphs is that the latter are genetic mosaics, while in the former all parts of the body are presumed to be of similar genetic constitution. Male and female parts of gynandromorphs occur in distinct regions, while intersexes are either male with a greater or less female tendency or female with a greater or less male tendency.

G. M. F.

A Hereditary Variation in *Habrobracon*.—P. W. WHITING ("Influence of Age of Mother on Appearances of a Hereditary Variation in *Habrobracon*," *Biol. Bull.*, 1926, 51, 371–384, 1 pl.). Two cases of marked hereditary deficiency are described in the parasitic wasp *Habrobracon juglandis* (Ashmead). In one, deficiency in genitalia was associated with deficiency in digestive tract, and many immature deaths occurred. In the other case deficiency in genitalia was associated with deficient antennæ. There was no increase in immature deaths over those normally occurring, but much female sterility. Percentage of deficient offspring varies according to the age of the mother in both cases. It increases up to approximately the tenth or fourteenth day of adult life and then decreases. It has been shown that linkage in *Drosophila* varies with the age of the mother. If this is true in *Habrobracon*, a difference in genetic composition of offspring according to the mother's age may be brought about.

G. M. F.

Chromosome Map in *Drosophila*.—O. L. MOHR ("Contribution to the X-Chromosome Map in *Drosophila melanogaster*," *Nyt Magazin for Naturvidenskaberne*, 1927, 65, 265–273, 2 text-figs.). A single female with defective wing

margins was found in the culture which served as stock for the II-chromosome recessive fat (Mohr, 1923), and which on that day contained 80 ordinary fat flies. The female was crossed to wild type males, and the wing character following, called *Ragged* (R), reappeared in 56 out of 98 sons and daughters obtained. In order to investigate to which chromosome the new gene belonged, *Ragged* males were, as a first step, crossed to females that carried recessive genes belonging to the different linkage groups. When the flies started hatching, all the daughters were *Ragged* and the sons were wild type, thus indicating that the new gene was sex-linked. The author describes investigations carried out on this and other linkage tests, and concludes, in view of the striking similarity in all principal points between the characters *Beadex* (discovered by Bridges) and *Ragged*, there is every reason to believe that both are mutations in one and the same locus. M. E. M.

Biology of Gyrinidæ.—M. H. HATCH ("Notes on the Biology of *Dineutus* (*Gyrinidæ*)," *Bull. Brooklyn Ento. Soc.*, 1927, 22, 27–28). For about twenty years *Dineutus* (s. str.) *ciliatus* (Forsberg) (= *vittatus*), Germ., has been collected in a small stream in Framingham, Mass. The stream has a sandy bottom, is about 5 feet wide, from 6–10 inches deep, and the current at the middle is one foot a second or less. The beetles are more inclined to stay near the bank, but frequently move out towards the middle, where their behaviour is similar to that described by the author for *Dineutus* (*Cyclinus*) *discolor*, Aubé, in a previous number of this journal (1925, 20, 105–106), which were living in a current of about 8 inches per second. Further observations on the habitat of *Dineutus* (especially exotic species), *Andogyrus*, *Macrogryus*, and *Enhydrus*, are desirable. The author concludes his paper with a key to the first instar larvæ of the local species of *Dineutus*, *Cyclinus*. M. E. M.

New Ants.—W. M. WHEELER ("The Ants of Lord Howe Island and Norfolk Island," *Proc. Amer. Acad. of Arts and Sci.*, 1927, 62, 121–153, 12 text-figs.). The present paper completes the description of ants sent to the author by Mr. A. M. Lea from the Lord Howe and Norfolk Islands, and furnishes a comparative study of these ants with those of Australia, New Zealand, and other neighbouring regions. The following species are dealt with by the author. LORD HOWE ISLAND.—*Amblyopone australis cephalotes*, F. Smith, var. *howensis*, Wheeler; *Amblyopone leæ*, Wheeler; *Ponera pallidula*, Emery; *Monomorium* (*Notomyrmex*) *howense*, Wheeler; *Monomorium* (*Lampronmyrmex*) *læve fraterculus*, Santschi; *Lordomyrma leæ*, Wheeler; *Tetramorium guineense*, Fabr.; *Orectognathus antennatus*, F. Smith, var. *howensis*, Wheeler; *Strumigenys leæ*, Forel.; *Iridomyrmex glaber sommeri*, Forel, var. *ianthinus*, Emery; *Technomyrmex albipes*, F. Smith; *Paratrechina* (*Nylanderina*) *obscura*, Mayr.; *Paratrechina* (*Nylanderina*) *minutula*, Forel; *Camponotus* (*Colobopsis*) *howensis*, Wheeler. NORFOLK ISLAND.—*Amblyopone australis cephalotes*, var. *norfolkensis*, Wheeler; *Ponera leæ oculata*, Wheeler; *Ponera mina*, Wheeler; *Pheidole amplo norfolkensis*, Wheeler; *Monomorium* (*Notomyrmex*) *sanguinolentum*, Wheeler; *Monomorium* (*Lampronmyrmex*) *læve fraterculus* Santschi; *Carduocondyla nuda nereis*, Wheeler; *Tetramorium guineense*, Fabr.; *Tetramorium antiopdum*, Wheeler; *Strumigenys leæ*, Forel; *Iridomyrmex albicans*, Wheeler; *Paratrechina* (*Nylanderina*) *vaga*, Forel. M. E. M.

The Insect Thorax.—R. E. SNODGRASS ("Morphology and Mechanism of the Insect Thorax," *Smithsonian Miscellaneous Collections*, 1927, 80, 108, 44 text-figs.). In a comprehensive paper of 108 pages the author has dealt with the insect thorax under the above title. It should be consulted by all interested in the subject, as the large investigation undertaken cannot very well be summarized with justice

to the work. As the author says, "If we had but to describe the thorax as it is, the task of the anatomist would not be a simple one, but it is always necessary to look beyond the facts that confront us and to discover the more fundamental structures upon which they are reared, an undertaking which requires redoubled effort, but without which there can be no true morphology." "Facts and theories should run parallel; in entomology, it seems, they often diverge. Some theories, however, have served as useful stepping-stones, though they themselves have later been swept away by the current." The author discusses and compares several theories of the evolution of the insect thorax, and his conclusions appear to favour the theory of Weber (1924).
M. E. M.

Ants of the Canary Islands.—W. M. WHEELER ("The Ants of the Canary Islands," *Procs. of the Amer. Acad. of Arts and Sciences*, 1927, 62, 1-120, 3 pls.). The author visited the Canary Islands in the summer of 1925, and during his visit was able to collect and observe a considerable number of the species, sub-species and varieties of the *Formicidæ* known to occur in the archipelago. In table-form a list of 56 forms (species, sub-species and varieties) now known is given, with an indication of their occurrence in the various islands. Forty-seven of them have been taken in Teneriffe, seventeen in Gran Canaria, nine in Lanzarote, eight in Palma, seven in Fuerteventura, two in Gomera, and only one in Alegranza. None have been recorded from Hierro or Graciosa. The small number cited from all the islands, except Teneriffe, is said to be explicable in great part from the fact that they have been little explored by entomologists. It is thought to be highly improbable that so large an island as Hierro should be antless, or that Gomera should have only two species. The author includes a descriptive list of the 56 forms and their synonymy.
M. E. M.

The Nearctic Ant-Lions.—N. BANKS ("Revision of the Nearctic *Myrmeleonidæ*," *Bull. of the Museum of Comparative Zoology at Harvard College*, 68, 3-84, 4 pls.). The Nearctic *Myrmeleonidæ* are chiefly a northward extension of the Neotropical fauna, thus Texas, New Mexico, and Arizona are the most favoured states. Several of the genera, as, for instance, *Brachynemurus*, *Hesperoleon*, *Austroleon*, *Ganurus*, and *Psammoleon*, are common in Central and South America, but do not occur in the Old World. The genus *Myrmeleon* occurs in all continents, and is everywhere fairly common. *Dendroleon* does not occur south of the United States, but is represented in Europe and Asia, in the latter country with numerous species. It is more common in the Eastern than in the Western States. *Hesperoleon* has but one or two species in the Eastern States, but many in the Western States. The family, originally of but one genus, has undergone many changes, until now there are four sub-families and nearly a dozen tribes. The author gives a very full descriptive list of the species under review, and descriptions of all the species that come under the review.
M. E. M.

New Scale Parasites.—H. COMPERE and H. S. SMITH ("Notes on the Life-History of Two Oriental Chalcidoid Parasites of *Chrysomphalus*," *University of California Publications in Entomology*, 4, 63-73, 13 text-figs.). The two parasites treated in this paper, namely, *Casca chinensis* (Howard) and *Comperiella bifasciata* (Howard), are thought of possible value if established in the countries where their hosts are pests of importance. In China and Japan both of these parasites attack the Californian red-scale, *Chrysomphalus aurantii* (Mask.) and the Florida red-scale, *Chrysomphalus aonidium* (Linn.), and *Casca* also attacks the purple-scale, *Lepidosaphes beckii* (Newman). The parasites were introduced into California by the University of California for the purpose of combating red-scale, *C. aurantii*,
2 c 2

and the purple-scale, *L. beckii*, both serious pests of citrus fruits. These parasites were obtained in 1924 from China and Japan. It has been shown that *Comperiella* is unable to develop in the *C. aurantii* which occurs in California. The parasite is now established on *C. aonidium* at the Huntington Estate, San Marino, California, and at the Mesick Nursery, Montebella, California. The probable economic value of *Casca* cannot be predicted. Apparently the species has not succeeded in reproducing itself in the orchards, and the authors have not been able to maintain the species in the laboratory. The paper mainly consists of a description of the morphology and life-history of these two species, including descriptions of the egg, larva, and adult.

M. E. M.

Mutating Character in *Drosophila Virilis*.—M. DENEREC ("Magenta-Alpha, a Third Frequently Mutating Character in *Drosophila virilis*," *Procs. Acad. of Sci.*, 1927, 13, 249-253). In his preliminary reports on the behaviour of reddish and miniature-a, the author presented evidence which indicated that both of these characters frequently mutate to the wild type. In the case of reddish the mutable condition of the gene was limited to the reduction-division of the heterozygous females, and the gene for miniature-a was found to be mutable in all stages of the development, in the germ cells as well as in the somatic cells. Magenta-a eye-colour character is the third mutable character found in *D. virilis*. Mutations to wild type were observed at the reduction-division of homozygous and heterozygous females, in males, and in a few cases in somatic cells. The author describes the observations from which his conclusions are drawn.

M. E. M.

Crustacea.

Anelasma Squalicola.—J. JOHNSTONE and W. E. FROST ("The Cirripede Fish Parasite *Anelasma squalicola* (Lovén)," *Rep. for 1926 on the Lancashire Sea-Fisheries Lab., Liverpool*, 1927, 29-91, 6 pls. and 6 text-figs.). *Anelasma squalicola* (Lovén) is a barnacle which becomes rooted in the dorsal muscles of the dogfish *Bimopterus spinax*: an exhaustive and beautifully illustrated account of this parasite which does not lend itself to abstraction.

G. M. F.

Excretory Organs of Crustacea.—H. GRAHAM CANNON and S. M. MANTON ("Notes on the Segmental Excretory Organs of Crustacea," *J. Linn. Soc. Zool.*, 1927, 36, 439-456, 7 text-figs.). The paper consists of four studies, each with references to the literature. The first deals with the pattern of the maxillary glands in the Branchiopoda and in *Anaspides*; the second with the sphincter valves of maxillary glands of *Chirocephalus* and *Anaspides*. Study No. 3 refers to the segmental excretory organs of the Mysid *Lophogaster typicus*. As was expected, this representative of the common ancestral type of the Amphipoda and the Isopoda possesses both antennal and maxillary glands; the two glands are similar in structure and both closely resemble the antennal gland of *Hemimysis lamornæ*. No. 4 deals with the antennal glands of some Euphausiacea and of the Venæid prawn *Gennadas elegans*. The antennal gland of the latter is noteworthy, the adult having a duct which has not yet become labyrinthine, and also a well-developed valvular apparatus between duct and end sac.

J. F. C. H.

The Abdominal Muscular Systems of the Common Shrimp (*Crangon vulgaris*).—R. J. DANIELS (*Rep. for 1926 on the Lancashire Sea-Fisheries Lab., Liverpool*, 1927, 92-158, 3 pls. and 2 text-figs.). An exhaustive anatomical investigation of the abdominal musculature of the shrimp.

G. M. F.

Annulata.

Archiannelida.

Some New Marine Archiannelids.—A. REMANE ("Diagnosen neuer Archianneliden (zugleich 3, Beitrag zur Fauna der Kieler Bucht)," *Zool. Anz.*, 1925, 65, 15-17, 4 text-figs.). During his searches for Aberrant Gastrotricha in the vicinity of Kiel and near Heligoland, Remane has found some hitherto unknown species of marine worms of microscopic size. He now describes two species belonging to the family Dinophilidae, viz., *Trilobodrilus heideri* nov. gen. nov. spec. and *Diurodrilus minimus* nov. gen. nov. spec., and two others of the family Nerillidae, viz. *Nerillidium gracile*, nov. gen. nov. spec., and *Nerillidium troglodytes*, nov. spec. These new forms vary in length from 2 mm. to 250 μ . D. B.

Rotatoria.

Alternation of Generation in Rotatoria.—A. LUNTZ ("Untersuchungen über den Generationswechsel der Rotatorien. I. Die Bedingungen des Generationswechsels," *Biol. Zentralbl.*, 1926, 46, 233-256, 257-278). Experiments were undertaken to determine, with the aid of more exact rearing methods, whether the alternation of generations in *Pterodina elliptica* Ehrbg. is due to external factors or internal rhythmical processes. *P. elliptica* was raised in 0.05 p.c. Benecke's solution and fed on *Polytoma urella*, *Chlamydomonas pulvisculus* and *Chromulina minor* (in pure cultures on agar). The pH of the nutrient solution was buffered by Sørensen's method. If the conditions were kept constant, reproduction was purely parthenogenetic (96 such generations were observed when feeding with *Polytoma*). If the food was changed, ♂ appeared. When changed from *Polytoma* to *Chlamydomonas* or *Chromulina*, 96 p.c. ♂ appeared. With the reverse change there appeared likewise 96 p.c. ♂. With a change from *Chromulina* to *Chlamydomonas* or the reverse there appeared but 50 p.c. ♂. Males appeared with a change to 0.1 p.c. nutrient solution, as well from higher as from lower concentrations. There were but 20 p.c. ♂ produced in this way, since the change of concentration reacts only upon the last eggs. pH has the following effect: in solutions of 0.01 p.c. and 0.05 p.c. the animals give 96 p.c. ♂ with the change from *Polytoma* to *Chlamydomonas* only at pH 6.8-7.6; above and below these limits there is no reaction to change of food. In 0.1 p.c. solution the animals react to change of food between pH 6.8 and 8.0, giving 100 p.c. ♂; between pH 6.6 and 8.2 with 96 p.c. ♂. Above and below these limits the reaction is again suppressed. In 0.005 p.c., 0.0025 p.c. and 0.15 p.c. solutions there was no reaction to change of food. If food and temperature were both changed, the percentage of ♂ was raised. Quantity of food had no effect on the production of ♂. It is therefore possible to call forth bisexual reproduction by external stimuli. That no internal rhythmical process are responsible is shown by the fact that after more than 90 parthenogenetic generations as well as several successive bisexual periods, the reaction to change of food remains at the same level. The effective factor is not a random specific stimulus, but the alteration of the conditions of life. *Melicerta ringens* and *Stephanoceros fimbriatus* also respond to food changes by ♂ production, but the cultures are difficult to maintain, and a detailed study was not possible. *Biological Abstracts.*

The Life-History of Rotifer vulgaris.—F. W. SPEMANN ("Über Lebensdauer, Altern und andere Fragen der Rotatorien Biologie, nach Beobachtungen an rotifer vulgaris," *Zeits. wiss. Zool.*, 1925, 123, 1-36). In the earlier stages of the cultures which have yielded the results now reported, some difficulty was experienced

in finding a food on which isolated individuals of this particular species of rotifer would thrive under laboratory conditions. Various preparations of finely crushed starches, and also broths, such as are used for bacteria cultures, were tried without success. In no case could the cultures be carried beyond the second generation. Finally, on the advice of Prof. Lauterborn, a trial was made of *Protococcus*, which proved successful to the degree that cultures could at once be carried further, and when, after fifteen months, the studies were discontinued, the eighth generation had been reached. As it was observed that the rotifers only swallowed the very finest particles, the *Protococcus* was dried and then finely crushed. Individual rotifers carrying embryos were selected and placed in watch-glasses in 1 to 1½ ccm. of filtered lake-water. The young, when born, were isolated for daily observation and measured at intervals of 1 to 2 days while young, and of 2 to 3 days when older. From the whole series of observations the following results emerged: *Rotifer vulgaris* can be reared in isolation through several generations. Its period of growth is during the first 12 to 13 days, after which the size remains about the same. It produces, on the average, four young, but up to nine have been observed. The period of development of the embryo averages 8 to 10 days, the shortest period observed being 5 days. The first birth took place on the average on the 12th day, and the average interval between births was 5 days. Only 6 p.c. of the births led to the death of the parent, and in these cases the mother was already old. The maximum length of life recorded was 58 days, the average duration being 35 days.

D. B.

A New Study of *Apsilus vorax* Leidy.—C. L. CORI ("Zur Morphologie und Biologie von *Apsilus vorax* Leidy," *Zeits. wiss. Zool.*, 1925, 125, 587-584, 10 text-figs.). The author records the occurrence of this large but extremely rare rotifer on *Elodea* received from the aquarium of Prof. Urban of Plan, in Bohemia. From the examples found he was able to start a series of cultures and to carry these on until the time of writing, a period of fully a year and a quarter, the animals, meanwhile, increasing greatly in number. They were supplied with their natural food (*Paramecium*, *Stylonichia*, Rotifers, free-living Nematodes, and Cyprids, separately cultured for the purpose). *Apsilus vorax* is viviparous. The young are born in the morning, and after swimming about for a few hours, affix themselves to the place of their choice, to remain there, under normal conditions, until their death. After affixment they somewhat contract themselves, and so remain for six to seven days, during which no food is consumed, but the developments take place which change the free-swimming larval form into the perfect and sessile adult, provided, for the capture of its prey, with the great funnel-like expansion characteristic of the genus to which it belongs. In the change there have been lost the eyes and the ciliated corona, and the position of the anus has become ventral in place of dorsal. With such a life-history it was possible to watch under relatively high magnifications the growth and development of the animals from the moment of their affixment to the close of their lives, and to note day by day the changes observed. The structure and form of both the larval and the adult stages, the various organs and the elaborate muscular system, are described in full detail. In addition to the usual dorsal and paired lateral antennæ, this species possesses a pair of tactile organs within the funnel-like "net," placed in positions corresponding to those of the lateral antennæ on the outside, and linked with them by underlying nerve-cells. In the body cavity are found wandering amœboid cells, to which is attributed the function of assisting the nephridial system in the disposal of excreta, and for these the name of "excretophores" is suggested. The larval form has a length of 200-250 μ . The largest adult seen measured 635 μ . Among several life-

histories printed *in extenso* is one of an example which lived for 42 days and had 70 descendants (nine daughters and their progeny). No other example exceeded this in duration of life.

D. B.

Rotifera from the Black Forest.—J. HAUER ("Rotatorien aus dem 'Wuhrholz' im Ried bei Donaueschingen," *Schr. Ver. Gesch. Naturgesch.* Baar Donaueschingen, 1926, H. 16, 252–272, 10 text-figs.). A list, with useful figures and notes, of 49 species of Rotatoria collected by the author in sphagnum and other pools in the "Wuhrholz" in the marsh near Donaueschingen in Baden. Among the rarer species found, there are *Notommata copeus* (Ehrenberg), *Euchlanis lyra* Hudson, *Lecane amorpha* Hanning, *Mytilina bicarinata* (Perty), *M. trigona* (Gosse), and *Collotheca heptabrachiata* (Schoch).

D. B.

Variation in Brachionus.—P. DE BEAUCHAMP ("A propos des formes réduites de *Brachionus bakeri* Müller et *Br. furculatus* Thorpe," *Bull. Soc. Zool., France*, 1927, 52, 61–67, 1 text-fig.) (see *J. Roy. Micr. Soc.*, 1926, Ser. II, 46, 143–144). Referring to the variations exhibited by certain species of the genus *Brachionus*, the author designates as "formes exubérantes" those forms whose variation from the type consists in excessive development of the lorica, of the spines or of the ornamentation, whilst those which vary in the contrary direction he designates "formes réduites." There is greater difficulty in the case of the "reduced" forms in recognizing the species to which they belong. In this note he points out the several constant characters by which "reduced" forms of the two species named in title may be unfailingly distinguished and referred to their proper type form. It is incidentally stated that the author has been breeding *Br. furculatus* for four years, feeding the animals with flagellates "à l'état pur."

D. B.

Nemathelminthes.

A Revision of the Nematodes of the Leidy Collections.—A. C. WALTON (*Proc. of the Acad. of Nat. Sci. of Phila.*, 1927, 79, 49–163). This report is the first of a series covering the material of the Leidy nematode collection in the University of Pennsylvania, and of a further Leidy collection in the Academy of Natural Sciences of Philadelphia. The material consists largely of parasites from American hosts. A few, however, are from foreign animals in captivity. Although the majority of the specimens were unidentified, the collections contain many of the original Leidy species, as well as many known species. From material in the named part of the collections the author has redescribed and illustrated the little-known or hitherto doubtfully identified species. In all cases he has given the original as well as the present identification, and included such data as concerned the history of the specimen. He has also described many new species, which have been determined either from the unnamed material or from re-examination of the named specimens. The nomenclature both of parasites and of host animals has been changed in accordance with modern usage. A host list is given at the conclusion of the paper, and there is a full bibliography, comprising some 250 references.

J. L.

A New Ascarid in *Rana esculenta*.—M. KHALIL ("Un nouvel ascaride chez *Rana esculenta* de provenance Corse"), *Ann. Parasitol. Hum. et Compar.*, 1926, 4, 323–326, 3 text-figs.). *Amplificæum brumpti* (p. 323) from the prepyloric region of the stomach and the first 3 cm. of the intestine. A tabulation of the characteristics of the 6 known species of the genus is given.

Biological Abstracts.

Observations on Metastrongylus.—E. A. LEWIS ("Observations on the Incidence of *Metastrongylus brevivaginitus* and *Metastrongylus elongatus* in pigs in Central Wales," *J. Helminthol.*, 1926, 4, 123-126). Of 137 pigs examined from December to April, almost 50 p.c. were infested with *M. elongatus* or *M. brevivaginitus*, the former somewhat more commonly. The maximum number per pig was 407 (or 417). There are notes on the morphology of the parasites and on the condition of infested animals.

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The Female of Buissonia longibursa.—M. NEVEU-LEMAIRE ("La femelle de *Buissonia longibursa* Neveu-Lemaire, parasite du rhinocéros africain (*Rhinoceros bicornis*), *Ann. Parasitol. Hum. et Compar.*, 1926, 4, 85-86, 1 pl.). This Strongylid was found in the large intestine, Lake Rudolph region, E. Africa.

Biological Abstracts.

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eggs requiring 2-4 days. The young rhabditiform larvæ moult in 42-45 hours. Those of *Cylicostomum* have 8 intestinal cells, those of *Strongylus* 32. The second moult occurs in 5-8 days, the old skin being retained as a sheath. At ordinary temperatures larvæ were kept 4 months without losing motility. Exposure for 5-6 hours at -15 to -20° C. did not kill. They do not resist complete desiccation. Eggs of *Strongylus* are killed by exposure to sunlight. Attempts to obtain penetration of the skin by sheathed larvæ failed, but positive results were obtained by feeding.

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the latter. These are correlated with other types as follows: Gonophores with internal ectoderm, an umbrellar entoderm, originally with 4 radial canals; Medusæ, Eumedusoid gonophores. Gonophores with internal ectoderm, an umbrellar entoderm reduced to a layer arising directly at the periphery of the anlage of the medusa bud: Cryptomedusoid gonophores. Gonophores having internal ectoderm but no umbrellar entoderm: Heteromedusoid gonophores. Gonophores having neither internal ectoderm nor umbrellar entoderm: Styloid gonophores, fertile blastostyles. The two types described and figures are further subdivided: Cryptomedusoid, internal ectoderm preserving its epithelial character, with a sub-umbrellar cavity, gonophores free with velum, *Pachycordyle weissmani*, *Sertularia operculata*; sessile gonophores without velum, *Cladocoryne floccosa* ♀. Internal ectoderm loses its epithelial character and the gonophores are sessile, without sub-umbrellar cavity, *Cladocoryne floccosa* ♂, *Dynamena pumila*, *Gonothyræa loveni*. Heteromedusoid: Internal ectoderm persisting, *Thuriaria argentea*, *Laomedea conferta*, *Laomedea brochi*; internal ectoderm evanescent, *Laomedea flexuosa*. The author believes that certain details of the development of gonophores may have a greater systematic value than the organization of the adult gonophore; ultimately such details may be made a part of the diagnosis of genera and families.

Biological Abstracts.

Porifera.

The Spongillidæ of Europe.—W. ARNDT ("Die Spongillidenfauna Europas," *Archiv. Hydrobiol.*, 1926, 17, 337-365, 1 fig.). A comprehensive discussion of the freshwater sponges arranged as follows: (A) Key for the recognition of all hitherto described species of recent and fossil Spongillidæ of Europe. (B) Taxonomic list of the recent European Spongillidæ, giving author, publication, and distribution of each species. (C) Discussion of fossil Spongillidæ of Europe by geological ages, giving author, publication, and distribution of each species. (D) A brief reference to the abnormalities found in European Spongillidæ. (E) Table of synonyms occurring in the literature bearing on European distribution. (F) A discussion of the zoogeography and ecological distribution, indicating which forms occur out of Europe and which seem to have been recently introduced, and from where. An extensive bibliography and a distributional table conclude the article.

Biological Abstracts.

Protozoa.

Lambliophagy by Entamœbæ of the Gut of Man.—L. CHATRIDGE ("Lambliophagie durch Entamöben des menschlichen Darmes," *Arch. f. Schiff's u. Trop-Hyg.*, 1927, 31, 242). The ingestion of cysts and vegetative forms of *Lambia* by vegetative forms of *E. coli* in the gut of man is recorded. G. M. F.

Life-History of Euglena.—W. B. BAKER ("Studies in the Life-History of Euglena. I. *Euglena agilis*, Carter," *Biol. Bull.*, 1926, 51, 321-362, 2 pls., 16 text-figs.). Mitosis in *Euglena agilis* is similar to that described for higher plants and animals. Division of the nucleus is preceded by its migration anteriorly in the body. A chromatoid mass, the kinetic complex, originates from the endosome during the prophase and migrates to the periphery of the nucleus, where it divides. The division products pass to opposite sides of the anterior border of the nucleus, in which position they suggest homology with the centrophleparoplasts of *Trichomonas*. No paradesmose has been detected between them, however. From the kinetic complex a blepharoplast is freed and produces the main branch of a new flagellum. Later a basal body arises from each blepharoplast and from it is produced

the secondary branch or anchoring root of a flagellum. The entire motor apparatus of the parent animal, consisting of flagellum, basal body and blepharoplast, disappears during division and a new one is built up in each daughter animal.

The development of the motor organoids indicates relationship with diphasic amoeba on the one hand and with the complex parasitic flagellates on the other.

G. M. F.

Flagellata in the Cæcum of the Striped Ground Squirrel.—E. R. BECKER ("The Flagellate Fauna of the Cæcum of the Striped Ground Squirrel, *Citellus tridecemlineatus*, with special reference to *Chilomastix magna*, sp. nov.," *Biol. Bull.*, 1926, 51, 287–298, 1 pl.). The intestines of twenty ground squirrels contained the following protozoa: *Giardia* sp.? *Endamoeba citelli*. *Chilomastix magna*, sp. nov. *Trichomonas muris*, var. *citelli*, *Trichomonas* sp.? *Tetratrichomastix* (*Entrichomastix*) *citelli*, sp. nov., and *Hexamitus pulcher*, sp. nov. The first was found in the small intestine, all the others in the cæcum. All these protozoa appear to be commensals.

G. M. F.

Life-History of *Prorodon griseus*.—G. W. TANNREUTHER (*Biol. Bull.*, 1926, 51, 303–320, 34 text-figs.). *Prorodon griseus* is a Holotrichous ciliate and is recognized by its sub-terminal oral aperture, its rod-like structure enclosing the pharynx, and its terminal contractile vacuole. It has a single micronucleus and a single macronucleus. Binary fission and conjugation occur either while encysted or in the free forms. Conjugation is terminal, fusion occurring at their anterior ends. The old macronucleus persists during early conjugation and disappears by absorption within the cytoplasm. The new micronucleus and macronucleus are formed from the daughter nuclei. The reduction of chromosomes occurs in the second maturation division by a pairing of the eight chromosomes in the formation of the four bivalent structures. In the third division the pronuclei are at first connected by a drawn-out fibre.

G. M. F.

The Flagellate *Peranema trichophorum*.—R. P. HALL and W. N. POWELL ("A Note on the Morphology and Systematic Position of the Flagellate *Peranema trichophorum*," *Trans. Amer. Micr. Soc.*, 1927, 46, 155–165, 1 pl. and 2 text-figs.). The euglenoid flagellates *Peranema*, *Astasia*, *Menoidium* and *Euglenopsis* are compared in regard to the neuromotor system and the structure and function of the cytostome and gullet. Several discrepancies in the previous descriptions of *Peranema trichophorum* are pointed out. It is concluded that the retention of the terms *cytostome* and *gullet* for the structures so designated in *Peranema* and other Astasiidæ is justified. The departure of Calkins in splitting the old family Peranemidæ between the family Astasiidæ (Bütschli) and the family Heteronemidæ (Calkins) is entirely justifiable.

G. M. F.

A Marine Ciliate Favella.—A. S. CAMPBELL ("Studies on the Marine Ciliate *Favella* (Jørgensen), with special regard to the Neuromotor Apparatus and its rôle in the Formation of the Lorica," *Univ. Calif. Publ.*, 1927, 29, 429–452, 2 pls.). *Favella* is a largely neritic genus of the Tintinnoina. Its cytosome is trumpet-like, with a flattened, spiral frontal field. There are two macronuclei and two micronuclei. There is a complex neuromotor apparatus of intracytoplasmic fibres linking the motile organs with a central neuromotorium. The large loricas by their form and structure are adapted to pelagic life. The high specific surface and lightened structure add to the buoyancy of the organism. These loricas are formed from material elaborated in the cytoplasm and discharged largely by the mouth, dis-

tributed and fashioned by the neuromotor organs into the characteristic lorica which is of high survival value. The loricas afford a basis for the systematic allocation of the species in the Tintinnoina. G. M. F.

A New Trypanoplasma.—G. JOFF, M. M. LEWASCHOFF and W. P. BOSCHENSKO ("Trypanoplasma acipenseris nov. sp., ein neuer Blutparasit des Sterlets," *Russisch. Hydrobiol., Zeitschr.*, 1926, 5, 225–233, 2 text-figs.). More than half the sturgeons in the aquaria of the Volga biological station have trypanoplasmata. The length is from 9 to 41.8 μ , the breadth 3.1 to 9.3 μ . The blepharoplast is very elongated; two flagella are attached to its anterior extremity. There are a variable number of chromatic granulations. G. M. F.

The Toxoplasma of Fishes.—W. L. YAKIMOFF ("Le toxoplasme des poissons," *Centralbl. f. Bakt.*, 1926, 101, 217–220, 19 text-figs.). Toxoplasma is rare except in mammals and birds. From bream in the lake of Pidma, near Leningrad, the author has observed in smears of the liver and intestinal mucosa crescent-shaped bodies, 6 μ by 2.5 μ , and rounded forms of 6 μ in diameter: as a rule, there is only one nucleus, though there may be as many as four. G. M. F.

Hæmatozoa from Formosa.—M. OGAWA and J. UEGAKI ("Beobachtungen über die Blutprotozoen bei Tieren Formosas," *Arch. f. Protistenk.*, 1927, 57, 14–30, 3 pls.). *Hæmoproteus* has been found in the following birds:—*Pomatorhinus musicus*, *Turtur chinensis*, *Emberiza sulphurata*, *Otus bakkamæna glabripes*, *Zosterops palpebrosa peguensis*. *Proteosoma* has been found in *Zosterops palpebrosa juguensis*. A small parasite having eight merozoites has been noted in *Prinia extensicauda* and *Trochalopteryx taiwanum*: possibly it is the same as *Hamamocba tenuis* (Laveran and Mesnil). *Otus bakkamæna glabripes* harbours a leucocytozoon. Hæmogregarines were encountered in three snakes:—*Elaphe schmackeri*, *Ptyas korros* and *Natrix stolata*. Trypanosomes have been found in fish—*Fluta alba*, *Ophiocephalus maculatus*, *Clarias fuscus*, *Anguilla mauritiana*, *Polyacanthus opercularis*, *Flavidraco* sp. *Carassius auratus*; in birds—*Turtur chinensis* and *Areoturnix javanica rostrata*; in frogs—*Rana esculenta* and *R. plancyi*. Trypanoplasma has been noted in *Fluta alba*, *Clarias fuscus*, *Anguilla mauritiana* and *Carassius auratus*. G. M. F.

Survival of Spirostomum ambiguum.—P. M. JENKIN ("The Relation of *Spirostomum ambiguum* to the Hydrogen ion Concentration (alkaline range)," *Brit. J. Exp. Biol.*, 1927, 4, 365–377, 3 text-figs.). In media of pH 7.4 *Spirostomum* survives indefinitely, but in solutions of pH 9.4 they rapidly die after greater or less swelling. The time of survival decreases with increasing alkalinity, and between pH 9.0 and 7.6 is inversely proportional to the hydrogen ion concentration. Between pH 7.6 and 7.4 a very slight decrease in the hydrogen ion concentration will cause a very considerable and quite disproportionate decrease in the time of survival. G. M. F.

Tetradimorpha radiata, sp. nov. et gen. nov.; a Flagellate of the Family Rhizomastigidae.—TA-SHIE HSIUNG (*Trans. Amer. Micr. Soc.*, 1927, 46, 208–211, 1 pl.). This organism was found in two forms—the heliozoan or quiescent and the swimming form. The former is spherical, 27 μ –38 μ in diameter, and has numerous smooth straight axopodia 27 μ –65 μ in length. Highly refractile granules occupy the cortical zone, while the spherical nucleus, about 9 μ in diameter, is centrally placed. There are four flagellæ arising together from a slightly depressed area, where is situated a knob-like blepharoplast. In the swimming form the organism is pear-shaped: the axopodia are retracted into the cytoplasm. G. M. F.

The Zoochlorellæ of *Frontonia leucas*.—C. L. HOOD (*Biol. Bull.*, 1927, 52, 79–88, 3 text-figs.). *Frontonia* with zoochlorellæ require a medium of greater stagnation and putrefaction than *Frontonia* without zoochlorellæ. They may be freed from their zoochlorellæ by a gradual transference from their natural habitat to a medium of fresh spring water. The number of zoochlorellæ in *Frontonia* may be increased by increasing the degree of stagnation and putrefaction of the medium in which they live. *Frontonia* harbouring zoochlorellæ are more resistant to media of greater osmotic pressure than are free specimens. The difference between the hydrogen ion concentration of media in which *Frontonia* with innumerable zoochlorellæ are found and media in which *Frontonia* with no zoochlorellæ are found averages 0.3. The ability of *Frontonia* harbouring zoochlorellæ to live in a greater concentration of dextrose than *Frontonia* without zoochlorellæ is correlated with a greater hydrogen ion concentration caused by fermentation of the dextrose. Efforts to induce *Frontonia* without zoochlorellæ to gain them were unsuccessful. G. M. F.

Abnormal Tertian Parasites in Inoculated Malaria.—G. KÜHNHOLD ("Abnorme Formen von Malaria tertiana-Parasiten bei Impfmalaria," *Centralbl. Bakt. 1 Abt. Orig.*, 1926, 98, 113, 1 text-fig.). In a blood film from a paralytic inoculated with a tested strain of tertian malaria many schizogony stages were found, after the 15th febrile paroxysm, which resembled the typical rosette forms of quartan malaria (6–8 merozoites as opposed to the 18–24 of tertian). All other parasites (rings, half- and full-grown schizonts, etc.) showed pronounced tertian characters. If these abnormal schizonts only had been found, the type would have been diagnosed as quartan. That the single dose of .5 gm. of quinine could have been the cause is doubtful; perhaps the abnormality is related to the artificial infection. *Biological Abstracts.*

***Giardia cati* of the Domestic Cat.**—R. DESCHIENS ("*Giardia cati* R. Deschiens, 1925, du chat domestique (*Felis domestica*)," *Ann. Parasitol. Hum. et Compar.*, 1926, 4, 33–48, 3 text-figs.). The *Giardia* of the cat is a morphologically distinct species, of which there may be distinguished a short type (1.5–1.7 μ), a medium type (1.7–1.8 μ), and a long type (1.8–2.16 μ). Feeding cysts to a young cat resulted in diarrhæic stools 8 days later, with sparse vegetative forms and cysts. Two young mice and a young dog could not be infected by the same method. Comparisons with *Giardias* from various animals are presented. *G. cati* Deschiens and *G. felis* Hegner are almost certainly identical, the latter corresponding to the elongate type of *G. cati*. *Biological Abstracts.*

A New Species of *Blepharocorys* from the Stomach of Cattle.—V. DODIEL ("Une nouvelle espèce du genre *Blepharocorys*, *B. bovis* n. sp. habitant l'estomac du bœuf," *Ann. Parasitol. Hum. et Compar.*, 1926, 4, 61–64, 2 text-figs.). Though all of the previously known species of *Blepharocorys* (Infusoria) are from the cæcum or the colon of the horse, there is here described *B. bovis*, found commonly in the rumen of cattle at Leningrad, Sebastopol, and in Oriental Siberia. A table of the eight known species of the genus is included. *Biological Abstracts.*

A Dermatitis of Rainbow Trout Due to Infusoria.—A. DORIER ("Dermite mortelle à infusoires observée chez des alevins de truite arc-en-ciel," *Ann. Univ. Grenoble Sect. Sci.-Med.*, 1926, 3, 357–360, 2 text-figs.) *Enchelys parasitica* (p. 359), principal agent in a fatal disease of *Trutta iridea*. *Cyclochaeta domerguei* Wall. is also reported. *Biological Abstracts.*

Observations on Leishmania.—C. FRANCA ("Quelques considerations sur les 'Leishmania,'" *Mem. e. Estudos Mus. Zool. Univ. Coimbra*, 1926, 2, 7–13, 4 text-figs.). The author endeavours to clear up the confusion in the nomenclature of Leishmania. He believes there are two distinct genera, *Herpetomonas* and *Leptomonas*. *Leptomonas* has a blepharoplast, which gives rise to the flagellum, anterior to the nucleus. Non-flagellate forms are oval with a nucleus and blepharoplast. *Herpetomonas* has a blepharoplast anterior to the nucleus, but the thick flagellum arises from a rhizoplast. The non-flagellate forms are round or elliptical, with nucleus, blepharoplast and rhizoplast. *Biological Abstracts*.

Trichomonas in Calcutta.—B. M. D. GUPTA ("On a Species of *Trichomonas* Prevalent in Calcutta," *Indian Med. Gaz.*, 1926, 61, 10–14.). In six months 23 infections of *Pentatrachomonas* were found. These were cultured in Row's medium and lived 63 days at 37° C., being sub-cultured every third day. Kittens were fed a culture of *Pentatrachomonas*; three hours later numerous *Pentatrachomonas* were found in the cæcum of one cat. In another kitten, developing dysentery 30 days later, both *Pentatrachomonas* and coccidial oocysts were found in the stools; the kitten recovered, and later no protozoa were found in the stools. A culture of *Bodo* was fed to two kittens; the latter killed one and one and half hours later. No protozoa were found and cultures were negative. The author concludes that *Pentatrachomonas* is the form common in Calcutta, that it is a true parasite of the human intestine, and that nothing definite can be said as to its pathogenicity. *Biological Abstracts*.

Coccomyxa from the Sardine.—J. GEORGEVITCH ("Sur la *Coccomyxa* de la sardine," *Arch. Zool. Exp. et Gen. Notes et Rev.*, 1926, 65, 57–63, 1 text-fig.). The author observed at Monaco mixed infections of *Ceratomyxa truncata*, *C. sphærulesa*, *Sphæromyxa balbianii* and *Coccomyxa morovi*, in the gall-bladder of sardine (*Clupea pilchardus* Walf). *Coccomyxa morovi* Léger et Hesse is monosporous and polysporous. The young stage is a uninucleate mass of protoplasm, 6–10 μ in diameter. In monosporous development the nucleus divides into six; two form the spore membrane, two the sporoplasm, one the polar capsule, and the sixth remains as the vegetative nucleus. In polysporous development the body grows and the nucleus increases in number by series of divisions. Here again five nuclei are directly concerned with the development of the individual spore, and the sixth remains as the residual nucleus. *Coccomyxa* is more closely related in its mode of development and spore structure to *Myxosporidia* than to *Microsporidia*. *Biological Abstracts*.

Development of *H. stepanovi*.—E. MARZINOWSKY ("Du développement de l'*Hæmogregarina stepanovi*," *Ann Parasitol. Hum. et Compar.*, 1927, 5, 140–142, 2 text-figs.). The intermediate host of *H. stepanovi* from the turtle *Emys orbicularis* is a tick, *Hyalomma ægyptum*. Its nymphs and adults are found in abundance on the neck, head and tail region of the turtle. Cysts with eight sporozoites develop in the intestine of infected ticks and are ingested with their hosts by the reptiles. *Biological Abstracts*.

Gametic Meiosis in Monocystis.—G. N. CALKINS and R. C. BOWLING (*Biol. Bull.*, 1926, 51, 385–399, 17 text-figs.). A description of gametic meiosis of the species of *Monocystis* parasitic in the seminal vesicles of *Lumbricus terrestris* is given. The chromosome history of this gregarine does not bear out the generalization that zygotic meiosis is characteristic of all gregarines.

G. M. F.

Embadomonas cuniculi, n. sp.—J. COLLIER and W. C. BOECK ("The Morphology and Cultivation of *Embadomonas cuniculi*, n. sp.," *J. Parasitol.*, 1926, 12, 131–140, 1 pl.). *Embadomonas cuniculi* (p. 132), a parasitic flagellate of rabbits, described in detail, is uncommon, since it was found in the cæcum of only two out of more than 50 rabbits examined. Division occurs by binary fission. The plane of plasmotomy is morphologically longitudinal. The organism was cultivated in Locke-egg-serum medium, both at room temperature and at 37° C. The cultures at room temperature lived longer. Attempts to cultivate it in a medium used for free-living non-parasitic protozoa failed, and demonstrated that this organism is a parasite (commensal). Attempts to infect very young chicks indicated that, since the chicks were infected for only a short time, they could not serve as proper hosts for this flagellate. This seems probable also in the case of the rat.

Biological Abstracts.

Cytology of Tintinnopsis.—A. S. CAMPBELL ("Cytology of *Tintinnopsis nucula* (Fol.) Laackmann," *Univ. Calif. Public. in Zool.*, 1926, 29, 179–236, 4 pls., 7 text-figs.). A detailed morphological description, at a length of 57 uncut pages, of "this interesting, neglected, and large group of primarily marine, house-building ciliates." A remarkable, but probably not yet complete, description is given of a definite neuromotor system, and the author's study of both live and fixed preparations has done much to remedy the neglect complained of. The paper is, however, uncommonly verbose. Three times in three lines we learn that the mouth leads directly into the gullet; and we are informed, in all solemnity, that the "organs of defecation serve the organism in the function of the discharge of the solid remains of food." Readers, too, would be no less interested were they spared the reiteration, in introduction, text, discussion, and conclusions, of claims to priority in this or that observation. *Tintinnopsis* builds itself a house (lorica), and when the time comes for multiplication by division into two individuals, there arises a difficulty. Apparently half a lorica is not better than no house, so the house is inherited entire by the *posterior* of the two new individuals; but to equalize the bargain the lucky one lends some aid (apparently by provision of faecal matter) in building a new apartment for its fellow. Why the posterior individual should always be heir is not explained. Here, however, is precedent for the French pre-Napoleonic law of inheritance by which the after-coming of a pair of twins was heir before the earlier born. One has grown accustomed to "fiber," but is "pedicel" a misprint or an American spelling? J. F. C. H.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology.

Anatomy and Development of Tomato.—D. C. COOPER ("Anatomy and Development of Tomato-Flower," *Bot. Gaz.*, 1927, 83, 399–411, 2 pls. 7 figs.). A description of the anatomy and morphology of the flower of *Lycopersicum esculentum* Mill., based upon a study of the varieties Bonny Best and Greater Baltimore. The inflorescence is a racemose cyme of 7–12 flowers. The whorls of the flower are arranged spirally round the receptacle, and the development of the primordia is clockwise. Meristematic activity causes a lateral coalescence of the members of each whorl, and finally the stamens and petals form a continuous zone, so that the stamens appeared to be outgrowths of the petals. Each sepal, petal, stamen and carpel receives a vascular bundle from the cylinder of the receptacle. The calyx has a short tube with six lobes; the mesophyll is loose with many chloroplasts. The corolla has a short tube with six broad lanceolate lobes. The six stamens connive to form a cone round the pistil, and although at first free, they finally appear to be inserted on the throat of the corolla; they dehisce introrsely and longitudinally. The pistil is composed of six united carpels. Both calyx and corolla bear glandular hairs, and multicellular, non-glandular hairs occur on the style, calyx and corolla. All the floral organs bear unicellular papillary hairs. The pedicel, calyx and style bear stomata, but none were found on the corolla or ovary. S. G.

Structure and Development.

Vegetative.

Auxiliary Vascular Bundles in Hypertrophied Tissues.—H. LONAY ("Les Satellites, entités libéroligneuses constituant une vascularisation auxiliaire dans certains organes hypertrophiés," *Bull. Soc. Roy. Bot. Belg.*, 1926, 59, 13–18, 3 figs.). In certain conditions of development the petioles of *Hæmanthus Lindenii* may undergo hypertrophy by rapid proliferation of the mesophyll parenchyma. The petiole assumes the functions of an organ for storing reserve food materials for the nutrition of adventitious buds. In the pericyclic region of the vascular bundles the ground tissue becomes modified and develops new structures which the author calls "Satellites." These resemble vascular bundles in miniature; in favourable circumstances they may form a ring completely surrounding the mother bundle. A pericyclic cell divides repeatedly to form a mass of procambial tissue which eventually gives rise to a satellite consisting of three principal sorts of element: digestive cells in contact with the surrounding storage parenchyma, phloem and xylem. In this way there is developed a network of auxiliary vascular bundles which explore the storage tissue in the neighbourhood of the main bundle. Occasional isolated satellites have been observed. It is supposed that the isolation of these is only temporary, their subsequent development being influenced by a sort of chemiotaxis directing them towards other satellites which are already in contact with the xylem elements of the main bundle. B. J. R.

Occurrence of Large Rays in Wood.—W. W. TUPPER ("Woods with Conspicuously Large Rays," *Tropical Woods*, 1927, 11, 5-9.). The author has compiled a list of 90 genera representing 28 families in which broad rays have been observed. This anatomical feature is of considerable value for identification and classification. Although there is a complete series of gradation from large and prominent compound rays to the uniseriate type, nevertheless the rays in some instances are so strikingly prominent without any magnification that segregation of such woods can be quickly and easily accomplished. When other general characteristics are taken into account, it is generally possible to identify the genus of any wood included in this category.

B. J. R.

CRYPTOGAMS.

Pteridophyta.

***Psilotum triquetrum*.**—H. S. HOLDEN ("Some Vascular Abnormalities in the Aerial Stem of *Psilotum triquetrum*," *New Phytologist*, 1927, 26, 260-268, 8 figs.). A brief description of the normal stelar anatomy of *Psilotum* is given. Two stems showing vascular abnormality were also investigated. In one of these the stele becomes ovoid and then divides, one branch dwindling and the other persisting; this may represent an almost complete suppression of one shank of a dichotomy. In the second abnormal specimen the stem, which at its upper end is divided into several small irregularly grouped branches, contains three independent main steles, the largest of which subsequently undergoes bifurcation. The vascular supply of the branches is derived from these main steles by subdivision. The main steles show a little secondary xylem locally, and the core of intraxyletic sclerenchyma is, in part, replaced by parenchyma. From the tips of the xylem arms arise a number of small traces, which resemble the leaf-traces in *P. flaccidum* and may be regarded as leaf-traces, though not normally present in *P. triquetrum*.

A. G.

Hongkong Ferns.—L. GIBBS ("Common Hongkong Ferns," 1927. Hongkong: Kelly and Walsh, Ltd., pp. x and 85, 42 pls.). Illustrations and descriptions of 42 common Hongkong ferns. The author is convinced that an accurate line drawing of a frond is far more helpful than the most careful verbal description can be, in the determination of the species. Accordingly he has prepared an account of the common ferns of Hongkong, as represented by drawings, supplementary details being added in the text. About one-third of the fern flora of the island is thus displayed.

A. G.

Bryophyta.

***Pellia Fabbroniana*.**—AMOS M. SHOWALTER ("Studies in the Cytology of the Anacrogynæ. IV. Fertilization in *Pellia Fabbroniana*," *Annals of Botany*, 1927, 41, 409-417, 3 pls.). In the fertilization of *Pellia Fabbroniana* it is found that the antherozoid applies itself to the surface of the egg and immediately is reduced in thickness; then it passes through the egg-membrane. It remains visible in the cytoplasm of the egg for about ten hours. Thereafter it approaches the female nucleus and becomes shorter and thicker. Vacuoles appear in cytoplasm around it, increase in number and size, and coalesce into one vacuole surrounding the male nucleus. This latter soon becomes optically non-homogeneous and loses its smooth outline. The fusion of the sexual nuclei occurs usually at

from 24 to 30 hours after the insemination of the female plants. The first segmentation of the zygote occurs usually on the sixth or seventh day. Cases of polyspermy are relatively frequent in this species. In most of these cases there is no nuclear fusion, and the zygote probably disintegrates. A. G.

Abnormality in *Mnium*.—GEORGE S. BRYAN ("Abnormal Sex Organs of *Mnium medium*," *Bot. Gazette*, 1927, 84, 89-101, 20 figs.). An investigation of the abnormal sex organs found in specimens of *Mnium medium* from Wisconsin. The moss is synoicous. Abnormal sex organs appear to be regularly formed by it. They may replace either an antheridium or archegonium, but usually they occur on the border between the peripheral ring of antheridia and the central group of archegonia. They differ widely in the details of their structure. Many of them are modified archegonia, some are modified antheridia, and a few show signs that the apical cell has functioned for a time like that of an antheridium, and later has changed to the archegonial type. A remarkable series of organs linking together antheridia and archegonia has been found. They add evidence to the hypothesis that the sex organs of the bryophytes are homologous structures. A. G.

Bastard Mosses.—R. TIMM ("Über Mossbastarde, insbesondere über die Kreuzungen und Mittelformen zwischen *Pogonatum aloides* (Hedw.) P.B. und *nanum* (Schreb.) P.B.," *Hedwigia*, 1927, 67, 1-44, 36 figs.). After giving a historical résumé of hybrid mosses which have been described in the past, the author discusses hybrids and intermediate forms between *Pogonatum aloides* and *P. nanum* which have been recorded, also stunted forms of *P. aloides* var. *minimum*, *P. Brosianum*, etc., and gives a bibliography of literature. A. G.

Portuguese Bryophytes.—ARTUR ERVIDEIRA ("Muscineas de Trás-os-Montes," *Boletim da Sociedade Broteriana*, Coimbra, 1927, 4, 3-8.). A list of 40 mosses and 10 hepaticæ collected near Poio, in the mountains of Marão, in the north of Portugal. The nature of the district is described, and attention is called to three of the plants, one of which, *Sphagnum Gravetii*, is a new record for Portugal, and two others are very rare. The article is preceded by a note in which Dr. J. Henriques gives an account of the principal bryologists of Portugal and of their publications. A. G.

Mosses of Kamtschatka.—HJ. MÖLLER ("Die Laubmoose Kamtschatkas," *Hedwigia*, 1927, 67, 86-98). An enumeration of the mosses of Kamtschatka founded on the older records of Tilesius, Chamisso and others, supplemented by the large collections of Hultén and Malaise in the Swedish Expedition of 1920-1922, which increase the total of species and forms to 144. A. G.

Hepatics of Kamtschatka.—H. W. ARNELL ("Lebermoose aus Kamtschatka," *Hedwigia*, 1927, 67, 110-112). A list of 28 hepatics collected by E. Hultén in Kamtschatka, with a description of a new species of *Nardia*. A. G.

Pacific Mosses.—H. N. DIXON ("Gilbert Islands Mosses," *Journal of Botany*, 1927, 65, 254-257). An account of the mosses collected by Rev. G. H. Eastman on eight islands of the Gilbert group of equatorial coral islands in the Pacific. Vegetation is scanty. Eight moss species were gathered, some being of wide distribution; one is a new species of *Hyophila*. A. G.

Bryological Notes.—H. N. DIXON ("Miscellanea Bryologica X," *Journal of Botany*, 1927, 65, 5-11). Among the more important points of this paper are the synonymy of *Thiemea Hampeana* C. Müll. and *Leptodontium squarrosum*.

Par. Attention is called to the three species of *Entosthodon* described by Mitten in Harvey's *Thesaurus Capensis*. The confusion surrounding *Hypnum remotifolium* is cleared away: *H. remotifolium* Grev. is *Eurhynchium remotifolium* Jaeg.; *H. remotifolium* Hook. f. & Wils. is *Eurh. asperipes* Dixon; *H. scabrisetum* Schwaegr. is *Eurh. scabrisetum* Paris; *Leskea remotifolia* Hook. is *Thuidium squarrosulum* Ren. & Card. Another difficult moss is *Leskea longirostis* Schwaegr.; this is *Stereophyllum longirostre* Dixon. A. G.

Thallophyta.

Algæ.

Alternation of Generations.—NILS SVEDELIUS ("Alternation of Generations in relation to Reduction Division," *Bot. Gazette*, 1927, 83, 362-384). A discussion of the alternation of generations, with a consideration of the antithetical theory of Čelakovsky and Bower and the homologous theory of Pringsheim, and of the cytological evidence introduced by Strasburger in support of the former theory. This theory seemed to provide a satisfactory explanation of the origin of the bryophytes, pteridophytes and phanerogams, consisting of a terrestrial sporophyte generation arising from and alternating with a more primitive gametophyte generation fitted for an aquatic life. But the discovery of a like alternation of generations in the algæ upsets the theory; for in algæ the two generations of algæ are often alike and live under identical aquatic conditions. Most of the Floridæ have a haploid generation with male and female organs, and a diploid generation with tetraspores; the reduction division takes place when the tetraspore mother cell divides. A complication is the diploid nature of the cystocarp. Also some Floridæ never form tetraspores; in such a case the reduction division occurs immediately after fertilization. These and other difficulties are discussed by the author, who assumes that in the course of evolution there has been a postponement in the time of occurrence of the reduction division. The sporophyte generation, which forms no gametes but spores only, is a result of delayed reduction division, and is morphologically homologous with the original haploid generation. A similar delay of the reduction division seems to have taken place in the diatoms. The plankton diatoms (*Diatomeæ centricæ*) are all probably haploid, with the zygote as the only diploid phase, while the *Diatomeæ pennatæ* are diploid, the gametes being the only haploid cells. It appears that there is far greater morphological correspondence between gametophyte and sporophyte than had previously been assumed, and this lends more support to the homologous theory of alternation than to the antithetical interpolation theory. As regards the theory of migration, the higher plants represent different stages in the migration of the plant world from water to land. And it is instructive to consider the position of the Phæophyceæ which never did migrate; here we find *Laminaria* with a very obvious sporophytic phase and with a very inconspicuous gametophyte which was not discovered till twelve years ago; *Laminaria* is comparable with the Pteridophyta. Then, again, there is *Fucus*, which anatomically resembles *Laminaria*, but differs in being the sexual plant. *Fucus*, however, is not haploid; the reduction division precedes the formation of eggs and spermatozoids. And the gametophyte is more completely reduced than even in *Laminaria*; no vegetative cells are produced, but spores only—macrospores and microspores; and it is peculiar to *Fucus* that the non-motile eggs are ejected from the oogonia, to undergo fertilization outside the mother plant. The *Fucus* plant is homologous with the sporophytes of *Laminaria* and *Dictyota*. In *Dictyota* the two generations are of equal size

and evenly balanced ; in *Laminaria* the sporophyte is dominant and the gametophyte insignificant ; in *Fucus* the gametophyte has disappeared, the spores are the only haploid stage, and they have likewise become gametes directly. *Fucus*, in the reduction of its gametophyte, stands at exactly the same point as the most advanced phanerogams. The reduction of the gametophyte cannot be explained as the result of migration to land. In seeking a biological explanation of the predominant development of the sporophyte over the gametophyte, the author discusses the significance of the reduction division in the alternation of generations, and shows that this lies in the facilities which it offers for the formation of new combinations of chromosomes in the daughter nuclei. There are, broadly, two distinct types of reduction division in the vegetable kingdom : (1) the fertilized diploid nucleus immediately undergoes reduction division, as in conjugatæ and haplobiontic Florideæ, where one fertilization is followed by one reduction division ; (2) reduction division is postponed and a diploid sporophyte is formed, from which many reduction divisions result, as in diplobiontic Florideæ, mosses, ferns, phanerogams. The following working hypothesis is proposed : the development of a diploid sporophyte, due to delayed reduction division, secures to the plant the possibility of bringing about numerous reduction divisions and thereby numerous combinations of chromosome characters. In the struggle for existence it is much more advantageous for the plant to become diploid than to remain haploid, since the diploid plant requires no more room, assimilates quite as well, and yet can produce, not only one but several kinds of gametes. Among the algæ it is obvious that the haploid Chlorophyceæ and Conjugatæ have failed to raise themselves to equality with such highly organized algæ as the diploid Phæophyceæ, *Sargassum*, etc. In the fungi the haploid Phycomycetes compare unfavourably with the Ascomycetes and Basidiomycetes. In the history of development, plants originally haploid have passed on to become diploid. The purely morphological alternation of generations is in appearance a kind of transition stage, lacking at the outset, and at the end once more disappearing.

A. G.

Finmark Planton.—K. MÜNSTER STRØM ("Plankton from Finmark Lakes," *Tromsø Museums Årshefter*, 1927, 49, nr. 1, 1-23, 1 fig.). There are some 20,000 lakes and tarns in Finmark. Collections of plankton were made in some of these by T. Soot-Ryen in 1924. The present paper is the result of a study of the material. The fauna and flora of each lake, with the relative frequency of the species, are tabulated. A systematic account of the plankton as a whole is given, with remarks on the distribution. In the algæ the results comprise 4 Peridiniæ, 7 diatoms, 4 Myxophyceæ, 15 Chlorophyceæ. The plankton is rather monotonous, the total bulk often great. All the lakes are situated in moraines and are shallow, which explains the occasional abundant presence of Myxophyceæ. The lakes were surveyed soon after the breaking up of the ice, and they may be referred to an arctic facies of eutroph lakes. For comparison a phytoplankton table of the lake Nedre Oksefjordvatn, examined in July, 1920, is given.

A. G.

North American Diatomaceæ.—CHARLES S. BOYER ("Synopsis of North American Diatomaceæ. Part I.—Coccinodiscatæ, Rhizosolenatæ, Biddulphiatæ," *Proc. Acad. Nat. Sci. of Philadelphia*, 1927, 78, Supplement, 1-228). A synopsis comprising all recent species of diatoms occurring in North America and the West Indies, with descriptions, type locality, distribution, published illustrations, and critical remarks. A series of keys to the genera and species is included. A. G.

Chinese Diatoms.—B. W. SKVORTZOW ("Diatoms from Tientsin, North China," *Journal of Botany*, 1927, **65**, 102-109, 1 pl.). An enumeration of 52 diatoms from a pond at Tientsin, including three new species and eleven new varieties.
A. G.

Cytology of Stigonema.—SYBEL LEE ("Cytological Study of *Stigonema mammosum*," *Bot. Gazette*, 1927, **83**, 420-424, 1 pl.). The cytology of the Cyanophyceæ has been studied in part, but the investigators are in disagreement. *Stigonema* is the subject of the present paper. It is shown that the cells of *Stigonema* act independently, although aggregated into a filament, often many cells wide. When a cell is rejuvenated at the surface of the filament, it produces a true branch, but when more deeply situated, it produces a group of vigorous cells, which, being surrounded by comparatively inactive cells, gives the filament a spotted appearance, whence arose the generic name. The central body is a primitive nucleus which has no nuclear membrane nor nucleolus, and no spindle during division.
A. G.

Aphanocapsa.—ANSELM MAYNARD KEEFE ("A New Species of *Aphanocapsa*," *Rhodora*, 1927, **29**, 39-41). A description of a new species of *Aphanocapsa* from a freshwater pond near Woods Hole in Massachusetts. The older colonies of *A. Lewisii* are large, attaining a diameter of 3-4 inches. The affinity seems to be with *A. delicatissima* West.

Soil Algæ.—B. MURIEL B. ROACH ("On the Carbon Nutrition of some Algæ isolated from Soil," *Annals of Botany*, 1927, **41**, 509-517). The algæ were extracted from a soil sample collected at Geneva, and consisted of a *Cystococcus*, two species of *Chlorella*, a *Chlorococcus*, and *Scenedesmus costulatus* Chod. var. *chlorelloides*. An account is given of their cultivation in daylight and in complete darkness, on media containing mineral salts enriched with various sugars. The five algæ can grow in complete darkness if provided with a suitable organic compound. They are true soil algæ, but they react quite differently to the conditions imposed upon them and vary in their capacity to grow in the dark. We must not regard the soil algæ as a homogeneous physiological unit in relation to soil fertility.
A. G.

Zygnema.—F. E. FRITSCH and F. RICH ("The Reproduction and Delimitation of the genus *Zygnema*," *New Phytologist*, 1927, **26**, 202-208, 2 figs.). In studying abundant material of *Zygnema peliosporum* Wittr. from Griqualand West, the authors have found that the zygospores are formed at one time in the canal, at another time in one of the conjugating cells; and they discuss the importance of these phenomena. To this species they would refer *Z. Collinsianum* Transeau and *Z. synadelphum* Skuja. They describe a new species from Griqualand West, *Z. fertile*, which produces azygospores. Some species of *Zygnema* exhibit an accumulation of mucilage in the conjugating cells, and these are referred by Transeau to the genus *Debarya*; but this is regarded as artificial and obscuring real affinities.
A. G.

Callithamnion.—M. A. WESTBROOK ("*Callithamnion scopulorum* C. Ag." *Journal of Botany*, 1927, **65**, 129-138, 15 figs.). An account of *Callithamnion scopulorum*, its habit and structure, and the characters of the tetrasporic plant, female plant and male plant, with their reproductive organs. Appended is a list of the times and places at which the three states of the plant have been observed at maturity by various authors.
A. G.

Callithamnion.—M. A. WESTBROOK (" *Callithamnion purpuriferum* J. G. Ag.," *Journal of Botany*, 1927, **65**, 161–167, 12 figs.). An account of the habit and structure of *Callithamnion purpuriferum*, of its male and female plants, its reproduction and polyspores. The species is South African. The proper generic position of the plant is discussed critically. A. G.

Colpomenia.—CAMILLE SAUVAGEAU (" Sur le développement du *Colpomenia sinuosa* Derb. et Sol.," *C.R. Acad. Sci., Paris*, 1926, **183**, 833–5). An account of the observations made by the author in studying some cultures of *Colpomenia sinuosa*. No copulation was observed; in germination the embryospores, where isolated, produced a cylindrical filament or protonema, in which one or more cells swelled, became again and again divided until a multicellular glomerule, a young *Colpomenia*, was constituted. Where the embryospores germinated in heaps, a different behaviour was noticed; the protonema produced a number of erect branches, sometimes terminated by a slender hair; sometimes a young *Colpomenia* glomerule was seen to be surrounded by an investment of such branches proceeding, as it were, from its base; but this ramification was found in cultures only, not in nature. Sauvageau found that these radiating branches eventually formed, usually at their distal end, a small *Colpomenia* glomerule, and their rôle may thus be considered to be adventive. He concludes that the protonema of *Colpomenia* indicates an affinity with *Phyllitis* and *Scytosiphon*, and not with *Cæpidium*. A. G.

Gametophyte of Nereia.—C. SAUVAGEAU (" Sur le gametophyte d'une Algue phéosporée (*Nereia filiformis* Zan.)," *C.R. Acad. Sci., Paris*, 1927, **184**, 1223–4). Cultures of *Nereia* from the Mediterranean were made, and afforded sufficient data to show that the embryospores in germinating produce a narrow primitive protonema, just as in the allied Sporochneaceous genus *Carpomitra*, and the distal end of this protonema swells out and forms a young *Nereia*. But the protonemas are usually dioicous; the males bear numerous bilocular antheridia; the females are slightly larger, they emit no free oosphere, and their terminal cell behaves like an apogamous oogonium. The chromatophores in the two generations being alike, it is difficult to determine precisely where the transformation to the sporophyte takes place. *Nereia* is a type less differentiated than *Carpomitra*. A. G.

Alternation in Sporochneaceæ.—C. SAUVAGEAU (" Sur un nouveau type d'alternance de générations chez les Algues brunes: les Sporochneales," *C.R. Acad. Sci., Paris*, 1926, **182**, 361–4). The small family of Sporochneales is mostly Australian in distribution, and is characterised by a peculiar mode of growth, and by having unilocular sporangia but no plurilocular organs. It is represented in Europe by the rare alga *Carpomitra Cabrerae*. Having investigated the life history of this plant in culture, the author describes the zoospores and the prothallia to which they give rise. The prothallus is monoicous, and from it grow antheridia and also the sporophyte; but no oosphere was observed. It may be that the mother-cell of the sporophyte germinates without fecundation, but the alteration of generations is established. A. G.

Canary Algæ.—F. BØRGESSEN (" Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria, III. Rhodophyceæ, Part I. Bangiales and Nemalionales," *Kgl. Danske Videnskabernes Selskab., Biol. Medd.*, 1927, **6**, pt. 6, 1–97, 49 figs.). As with the Chlorophyceæ and Phæophyceæ, so with the Florideæ it is found there is a great likeness between the algal flora of the Canary

Islands and that of the West Indian region. In the present paper an account is given of the Bangiales and Nematinales, 43 species being recorded; 7 of these are endemic, 6 being here described for the first time. Among the more difficult genera discussed are *Acrochæti*um, *Liagora*, *Galaxaura*. In *Galaxaura* the difficulty is increased by the existence of tetrasporic and sexual forms which have been described as distinct species; some of these in the West Indies have already been reduced by M. A. Howe in 1917 and 1918. A. G.

Sumatran Algæ.—B. W. SKVORTZOW ("On some Algæ from Sorei Lake, Sumatra," *Journal of Botany*, 1927, **65**, 198, 199). A list of 9 algæ collected amid a rich zooplankton by Baron E. E. Brugen in 1907 in Sumatra; among them is a new variety of *Staurostrum quadrifurcatum*. A. G.

Newfoundland Algæ.—WM. RANDOLPH TAYLOR and JOHN M. FOGG, Jr. ("Notes on some Freshwater Algæ from Newfoundland," *Rhodora*, 1927, **29**, 160–164). An account of the freshwater algæ collected in September, 1926, on the west and south coasts of Newfoundland, for the most part constituting new records, as the local algal flora was almost unknown. When compared with the mountain flora of British Columbia and of arctic Scandinavia, there is a marked similarity in the dominance of *Stigonema ocellatum* and *Scytonema myochrous* on wet rocks. No great abundance of *Nostoc* was found, though this genus plays an important part in British Columbia. The Coccogonales and Protococcales are more poorly represented than in British Columbia. A. G.

Chinese Algæ.—B. W. SKVORTZOW ("A list of Cyanophycææ from North Manchuria, China," *Journal of Botany*, 1927, **65**, 195–198). A list of 47 species and varieties of blue-green algæ collected near Harbin in North Manchuria during the last ten years. A. G.

Siberian Algæ.—B. W. SKVORTZOW ("Freshwater Algæ and Phytoplankton of the Lakes and Rivers of the Zaisan District, Altai Mountains, Siberia," *Journal of Botany*, 1927, **65**, 249–254, 4 figs.). A list of 113 species and varieties of algæ collected by A. N. Sedelnikoff in the Altai Mountains of South Siberia, including a new species and two new varieties. A. G.

Fungi.

Study of Phytophthora.—LEON H. LEONIAN ("The Effect of different Hosts upon the Sporangia of some Phytophthoras," *Phytopathology*, 1927, **17**, 483–90, 6 figs.). The paper is concerned with changes evoked in the fungus rather than the result on the host plant. A number of fleshy fruits and vegetables were inoculated with 85 different cultures of *Phytophthora*, giving a ready infection in nearly all cases. Though the general growth was alike in all, there were many morphological variations in the sporangia, both as to shape and size, due to the influence of different hosts. The writer concludes that these differences may lead to errors in identification, and recommends controlled cultural tests in the laboratory as providing more certain tests. A. L. S.

Water-Moulds in North America.—G. W. MARTIN ("Two unusual Water Molds belonging to the family Lagenidiaceæ," *Mycologia*, 1927, **19**, 188–90, 1 fig.). The moulds in question, *Myxocytium proliferum* and *Achlyogeton entophyllum*, were found attacking a large species of *Cladophora*. The writer has described their method of growth and their appearance as observed by him. A. L. S.

Occurrence of *Pythium gracile* in the United States.—F. K. SPARROW (*Rhodora*, 1927, 29, 37–41). The fungus was found infecting the filaments of *Spirogyra crassa* in a pond at Belmont, Massachusetts. A culture was made, and oogonia and antheridia were formed within the host-cells after nine days. At a later stage non-sexual reproductive stages appeared. The writer gives an account of the species; it has only once before been recorded in North America. A. L. S.

Aphanomyces euteiches as a Root Rot.—FRED REUEL JONES and CHARLES DRECHSLER ("Root Rot of Peas in the United States caused by *Aphanomyces euteiches*, n. sp." *Journ. Agric. Research*, 1925, 30, 293–325, 6 pls., 1 fig.). The disease due to this Phycomycete occurs in nearly all the pea-growing districts of the United States, and causes either the death or the dwarfing of the plants attacked. The parasite enters only by the cortex of the roots or base of the stem. A detailed account of the fungus is given, in cultures as well as in its parasitic condition. Experiments are also recorded of successful inoculation. It inhabits cultivated areas, and may be disseminated by any agent carrying soil. The disease can be best prevented by rotation of crops. A third successive crop of peas is often badly damaged. The new species forms sporangia with zoospores, oogonia and antheridia with oospores; the latter germinate without protracted resting period. All the stages are figured on the plates. A. L. S.

Study of Mucorales.—A. F. BLAKESLEE, J. L. CARTLEDGE, D. S. WELCH and A. D. BERGNER ("Sexual Dimorphism in Mucorales I. *Intraspecific Reactions*," *Bot. Gaz.*, 1927, 84, 27–50). The authors sum up by stating that "the investigations reported in the present paper were undertaken with the purpose of discovering whether among the heterothallic Mucorales sex intergrades could be found such as are frequently encountered in higher plants." A very large number of culture tests were made—2,000 races included in 34 or more species belonging to 12 genera. The tests proved that there was no evidence for sex intergrades: the heterothallic Mucors are sexually strictly dimorphic. II. *Interspecific Reactions*. A. F. BLAKESLEE and J. L. CARTLEDGE (*Tom. cit.*, 51–57). "The present study of interspecific reactions, in which an imperfect reaction called 'imperfect hybridization' is brought about, furnishes further evidence that sex intergrades in heterothallic Mucors are at least extremely rare in Nature, if not non-existent." A large series of cultures were made and the results tabulated. A. L. S.

Life-History of *Zygorhynchus Moelleri* Vuill.—ETHEL GREEN (*Ann. Bot.*, 1927, 41, 419–35, 10 text-figs.). The fungus was collected on the soil in Windsor Great Park. A history of previous work on the genus is given, and the methods of working are explained. The fungus grew more readily on media containing carbohydrate than on those containing only mineral salts, and zygospores were freely formed, as well as sporangia. It was observed that in zygospore formation the gametangia could fuse with another on the same zygospore or with those on independent hyphæ. Morphological differentiation or any differentiation of sex could not be determined. The zygospores germinated when mature in diffuse light on a varied series of cultures. It is concluded that *Zygorhynchus* seems to occupy an intermediate position "between isogamous homothallic Mucors and differentiated heterogamous homothallic forms" such as *Dicaranophora* and *Syncephalastrum*. The literature on the subject is fully cited. A. L. S.

***Sphærotheca Castagnei*.**—ILLO HEIN ("Studies on Morphogenesis and Development of the Ascocarp of *Sphærotheca Castagnei*," *Bull. Torrey Bot. Club*, 1927, 54, 385–417, 5 text-figs, 2 pls.). Hein has described the development of all

the parts: the envelope or perithecium, the formation of the sex cells, ascogone and ascus, the process of fertilization, after which there arises a column of three cells, of which the middle one is binucleated and develops to form the ascus. Further stages followed were the later formation of the perithecial well and the appendages which never form haustoria. A description is also given of epiplasmic granules in the ascus, which arise perhaps as minute droplets secreted by the cytoplasm. A full list of literature dealing with allied mildews is provided. A. L. S.

Germination in *Lachnea cretea*.—H. C. I. GWYNNE-VAUGHAN and H. S. WILLIAMSON (*Ann. Bot.*, 1927, 41, 489-95, 3 text-figs.). The experiments described were undertaken to investigate any difference that existed between *Lachnea abundans* Karst. and *Lachnea cretea* Phill. A prominent feature of both had been noted as the production of conidia on dichotomously branched conidiophores. Germinations of the conidia and of the ascospores were induced, and both ascocarps of *Lachnea cretea* and botryose conidia were obtained. Ascospores three and three-quarter years old germinated readily, but conidia of the same age had lost vitality. The writers consider it proved that the two fungi are identical. A. L. S.

Sclerotium Rolfii Sacc.—B. B. HIGGINS ("Physiology and Parasitism of Sclerotium Rolfii Sacc," *Phytopathology*, 1927, 17, 417-48, 8 figs.). *Sclerotium Rolfii* is a soil-inhabiting fungus that attacks and kills a great variety of cultivated and wild plants in the warmer sections of the United States. Cultural experiments were made to test the properties of the fungus which was obtained from pepper stems, potato tubers, peach seedlings, and a seedling of *Cedrus deodara*. Many different tests were made as to the composition of the various media. Filtrates were made and were applied to seedlings of tomato, soybean and pepper, and it was found that the injuries produced were similar to those produced by oxalic acid solutions. Toxicity also increased with the increase of H-ion concentration. Finally it was concluded that the death of the host cells was due to the toxic action of oxalic acid which was secreted by the fungus hyphæ. A. L. S.

Study of Bread Moulds.—C. L. SHEAR and R. O. DODGE ("Life Histories and Heterothallism of the Red Bread-Mold Fungi of the *Monilia sitophila* group," *Journ. Agric. Research*, 1927, 34, 1019-42, 4 pls.). This mould has been long known as a bakery pest; it was first reported in France in 1843 as *Oidium aurantiacum* and as *Penicillium sitophilum*. The conidial stage has been generally referred to as *Monilia sitophila*. The writers, by means of many cultures, have determined the perfect stage as a new genus of Pyrenomycetes *Neurospora*. The perithecium is ostiolate, the paraphyses disappear at an early stage, the spores become greenish-black and are longitudinally ribbed. Four species are described, each with a different *Monilia* stage. Cultures were made from the spores, and it was proved that *Neurospora* perithecia were produced only when two types of spore culture were grown together: it was heterothallic. Similarly, *N. sitophila* was found to be heterothallic. Of the other two species, *N. tetrasperma* is usually homothallic; *N. erythraea* is also probably homothallic. The ascospores did not germinate until heated in a moist condition for a few minutes at 65° or 70 C. A. L. S.

Sclerotinia and Monilia.—JOHN W. ROBERTS and JOHN C. DUNCAN ("Critical Remarks on Certain Species of Sclerotinia and Monilia associated with Diseases of Fruits," *Mycologia*, 1927, 19, 195-205). The writers have made an effort to clear up the confusion that exists as to *Sclerotinia* and the conidial stage *Monilia*. They find that two species occur on drupaceous and pomaceous fruits in America

—the common brown-rot fungus and a recently discovered form possibly identical with *Monilia cinerea* of Europe. The common brown-rot fungus is not identical with *Sclerotinia fructigena*, which has not been found in America. A. L. S.

Perfect Stage of *Hendersonia Mali*.—I. R. HESLER (*Mycologia*, 1927, 19, 222-7). By means of cultures the writer has obtained a perithecium from the conidia of *Hendersonia Mali*, originally found by him on apple twigs. Accompanying the conidial form were perithecia resembling those of *Pleospora*, and he has succeeded in proving their identity. The perfect stage he has named *Pleospora Mali*, n. sp. There follows a discussion on the probable relationships of this *Pleospora* to other members of the genus. A. L. S.

Study of *Diaporthe*.—LEWIS E. WEHMEYER ("Cultural Life Histories of *Diaporthe*," *Mycologia*, 1927, 19, 165-83, 3 pls.). The writer has made cultural studies on Leonian's Agar of a number of species of *Diaporthe*. *Diaporthe megalo-spora*, which is first described, was grown on agar media and then transferred to sterilized stems of *Sambucus*. The other species were *D. Peckii*, *D. rhoina*, *D. decedens* and *D. strumella*. The cultural results for each are fully described. The pycnidial stage was of the *Phomopsis* type in each, and the two types of spores were formed in each case except in *D. rhoina*, in which only the Alpha type was produced. The blackened zones characteristic of these fungi in natural conditions were reproduced in cultures. A. L. S.

Studies on *Podosphæra leucotricha* (Ell. and Ev.) Salm.—R. H. WOODWARD (*Trans. Brit. Mycol. Soc.*, 1927, 12, 173-204, 2 pls., 1 text-fig.). The fungus studied, known as apple mildew, has been an orchard pest for many years. The author in this exhaustive study deals with his subject under two main heads: (1) the mode of perennation and (2) observations on some host-parasite relationships. The field surveyed is thus a very wide one. He finds that the fungus perennates by means of hyphæ and haustoria within dormant apple buds: these are infected a full season before opening. The condition of the infected buds is described, as well as their distribution on the trees. The fungus fructification is also followed in detail—the character of ascus and spores and the method of dehiscence. As to infection, Woodward finds that the germinating spore hypha gains entrance rather by chemical than by mechanical action. A heavily-infected young leaf never attains its normal development. Apple varieties were found to vary in susceptibility; the attempts to prevent bud infection by spraying did not prove successful. A literature list of 41 numbers is appended. A. L. S.

***Aleuria repanda* Pers.**—JESSIE S. BAYLISS ELLIOTT (*Trans. Brit. Mycol. Soc.*, 1927, 12, 166-70, 4 text-figs.). The writer describes an abundant growth of this Discomycete on a damp jute rug in a dark shed. Any light came from a small hole in the door or from a chink at the base. Opportunity was thus afforded to observe the effect of light and to note the direction of growth, so that the discs achieved a position at right angles to the incident light. When advanced growth caused a distortion of the surface, the asci curved to the most favourable plane. A conidial condition of the fungus was also observed; conidiophores occurred on young fruit-bodies as growths from the external cells of the excipulum; colourless, simple ovate conidia were borne on the tips in clusters loosely attached by minute sterigmata. A. L. S.

***Dothichiza populea* and its Mode of Infection.**—GEORGE G. HEDGCOCK (*Phytopathology*, 1927, 17, 545-7). *Dothichiza*, a genus of Sphærospideæ, has been found to cause cankers on poplars. These arise nearly always at the nodes

of the branches, and cause a serious disease of the trees. The life-history of the fungus is imperfectly known, but infection experiments seem to have proved that the fungus attacks the leaves first and spreads to the twigs and branches, or gains direct entrance through wounds.

A. L. S.

Germination of Rusts.—W. E. MANEVAL ("Further Germination Tests with Teliospores of Rusts," *Phytopathology*, 1927, 17, 491-8). The writer here records further research on the germination of Uredine spores. He has given the results of growth tests as regards the length of time, the conditions of dryness, light or shade, the influence of chemicals and of H-ion concentration. Some spores germinated readily, others more slowly, and some required a rest period. Again, it was found that spores of some rusts formed late in the season apparently germinated more readily than those formed earlier. In a number of cases no germination was obtained, "probably because the incubation period was too short."

A. L. S.

Rusts and Smuts.—MALCOLM WILSON and J. S. L. WALDIE ("Observations on Some Scottish Uredineæ and Ustilagineæ," *Trans. Brit. Mycol. Soc.*, 1927, 12, 113-6). The authors describe six species of rusts: three of them are new to Britain, one has been previously reported from Kent, and two have occurred on new hosts. One species, *Æcidium importatum* Henn., occurred first in Berlin Botanic Garden on plants imported from North America. The origin of the host plants in Edinburgh Botanic Garden is not known, "but it is unlikely that they were obtained from Berlin." There is one smut, *Urocystis Anemonis*, on the petioles of *Ranunculus Ficaria* and *Trollius europæus*, both new hosts for Britain.

A. L. S.

Scutellum Rot of Corn.—BENJAMIN KOEHLER ("Studies on the Scutellum Rot Disease of Corn," *Phytopathology*, 1927, 17, 449-71, 6 figs.). The disease occurs on *Zea Mays*, and is very common in the United States. It is caused by various fungi—*Rhizopus*, *Mucor*, *Penicillium* and *Fusarium*. Immature seed was more susceptible to the attacks of the fungus than mature seed. In immature seeds it was found that there was more starch in the endosperm, and that seemed to be the principal factor concerned. Seeds with a more horny endosperm were less susceptible. Experiments to test susceptibility were made by growing fungi on extracts from different types of seed.

A. L. S.

Ceratostomella Pini Münch.—F. ZACH ("Zur Kenntnis von *Ceratostomella Pini* Münch.," *Zeitschr. Pflanzenkr.* 1927, 37, 257-60, 6 figs.). This fungus, which grows on pine stems, was described originally as forming perithecia. Zach has found by observation and by cultures on artificial media that it is a true Hyphomycete; the conidiophores tend to be massed together and form sclerotia like black dots on the stem. The development of the fungus is fully described.

A. L. S.

Observations on the Life-History of Helicodesmus, n. gen.—DAVID H. LINDER (*Amer. Journ. Bot.*, 1925, 12, 259-69, 2 pls.). Linder in this paper describes this new genus of Helicosporæ (Hyphomycetes). It differs from genera with similarly formed coiled conidia in its manner of growth; it produces, in natural condition, obvious white tufts of conidia, and the conidia are borne in chains. Many experiments were made as to the influence of light, temperature, etc., on the cultures. After conidial production, the fungus forms a pseudoparenchymatous mat.

A. L. S.

Polyporus sulphureus.—H. R. ROSEN ("A Pink-Colored Form of *Polyporus sulphureus* and its Probable Relationship to Root-Rot of Oaks," *Mycologia*, 1927, 19, 191-4, 2 pls.). The writer describes this peculiar form of a well-known *Polyporus*, which he has designated as *P. sulphureus* var. *Overholtsii*. A careful description is given of the fungus and of the damage it causes to oak trees.

A. L. S.

New Species of Cyphella.—ALBERT PILÁT ("Ein Kleiner Beitrag zur Kenntnis der Gattung *Cyphella* Fr. in der Tschechoslowakei," *Hedwigia*, 1927, 67, 113-7). Pilát describes two new species, *Cyphella callostoma*, which grew on dead roots of *Polypodium*, etc., in an orchid greenhouse in Prague, and *C. Bourdoti*, from dead leaves and stems of *Juncus*, sp., etc. He also adds three other species to the lists from Czechoslovakia which are also new to Central Europe.

A. L. S.

Polyporaceæ in Bavaria.—SEB. KILLERMAN ("Ueber zwei seltene Polyporaceen in Bayern," *Hedwigia*, 1927, 67, 125-30, 1 fig.). The author describes a rare species, *Polyporus xoilopus* Rostk. It was collected by him in a pine wood, and another species, also very rare, *Polyporus Wynnei* Berk. and Br. In addition he gives diagnosis and description of *Poria mycorrhiza*, n. sp., which grew underground on the roots of a beech tree, on which it formed a mycorrhiza. It is white at first but becomes reddish when exposed to the air. He considers its nearest affinity is with *Poria mollusca*.

A. L. S.

British Basidiomycetes.—CARLETON REA (Appendix to "British Basidiomycetæ," additions and corrections, *Trans. Brit. Mycol. Soc.*, 1927, 12, 205-30). Five years have elapsed since the publication of Rea's work. During this period additions have been made to the fungus flora of the country, and further investigations have necessitated several corrections. The genera added as new to this country are: *Leucogaster* (Hymenogastraceæ); *Tomentellina* (Hydnaceæ); *Asterostromella* (Thelephoraceæ); *Pistillina* (Clavariaceæ). A new sub-order, Septobasidiineæ, in which is the genus *Saccoblastia*, and under Tulasnaceæ the sub-genus *Glaetulasnella*. Several species new to science have been diagnosed by Rea, and a large and varied number of species, all marked "rare" or "uncommon," have been added. Workers in different parts of the country have contributed specimens.

A. L. S.

Fungi as Fermenting Agents.—CHARLES THORN and ELBERT C. LATHROP ("Psilocybe as a Fermenting Agent in Organic Débris," *Journ. Agric. Research*, 1925, 30, 625-8). The organic débris tested consisted of the crushed residue of sugar-cane from the mills termed bagasse. This substance heats quickly when piled up. A study of the fermentations led to the isolation of a species of *Psilocybe*. The mycelium of the fungus penetrates enormous masses of the bagasse and gives a yellow colour, the invasion of the fungus beginning at the outside and penetrating inwards. It developed rapidly, and the authors consider it as one of the greatest agents of fermentation ever discovered. The fruiting bodies of several agarics were formed, but the most abundant and the definite agent of the yellow fermentation was determined as a *Psilocybe* which has been provisionally identified as a new species by Peck—*Psilocybe atomatoides*. It is fawn-coloured and has a small pileus from 3 to 5 cm. in diameter.

A. L. S.

Biochemical Tests of Fungi.—SOPHIA SATINA and A. F. BLAKESLEE ("Further Studies on Biochemical Differences Between Sexes in Plants," *Proc. National Acad. Sci.*, 1927, 13, 115-22). The paper is a contribution to the National Research Council for Research on Sex Problems, and not only fungi, but also green

plants, were tested. In fungi the tests were made on the + and - races of *Mucors* as to their respective power of reducing permanganate of potash (KMnO_4). The material tested was alcoholic extracts of male and female plants. The methods are described. The results gained from a large number of tests showed a high average difference between the sexes, the female plants being the stronger reducers. It was found also that the stage of development of the plant is a factor of importance. In *Mucors* the best results were obtained with cultures 7-10 days old.

A. L. S.

Control of Soil Fungi.—H. E. THOMAS ("Some Chemical Treatment of Soil for the Control of Damping-off Fungi," *Phytopathology*, 1927, 17, 499-506). The paper is concerned chiefly with the damping-off of tomatoes and cabbage in the greenhouse caused by the fungi *Phytophthora* and *Rhizoctonia*. There was considerable variation in the effects—beneficial or otherwise—caused by the various chemicals used—copper carbonate, mercuric chloride and Uspulum. There was also little or no benefit unless the soil was treated before the disease appeared, and there was no evidence of chemical stimulation in any of the experiments.

A. L. S.

British Mycology.—E. M. WAKEFIELD ("The Hereford Foray," *Trans. Brit. Mycol. Soc.*, 1927, 12, 79-85). The writer has given an account of the Thirtieth Autumn Fungus Foray of the British Mycological Society, which was held in 1926 at Hereford. Excursions were made on four days to the surrounding country, descriptive accounts of which are given. A very large number of fungi, more especially of Basidiomycetes and Ascomycetes, is reported, and the other groups are also well represented. One new species, *Hygrophorus lepidopus*, was found at Moccas Old Park.

A. L. S.

Additions to Ceylon Fungi IV.—T. PETCH (*Ann. Roy. Bot. Gardens, Peradeniya*, 196, 10, 131-38, 2 pls.). The author has described a large number of new species in the various groups of fungi. Full descriptions and localities are given. The plates represent *Clathrus crispatus* Thwaites, not discussed in this paper.

A. L. S.

Revisions of Ceylon Fungi VIII.—T. PETCH (*Tom. cit.* 161-80). Fungi determined by previous workers in Ceylon are critically examined and redescribed. Species 343 to 379 are included in this survey. In many cases the genus has been changed.

A. L. S.

Fungi from Dominica.—RAFAEL CIFERRI and R. G. FRAGOSO ("Hongos parásitos y saprofitos de la República Dominicana (11ª Serie)," *Bol. Real Soc. Esp. Hist. Nat.*, 1927, 27, 265-80, 15 figs.). A further contribution to the fungi of Dominica. The present list comprises minute species, many of them causing diseases of plants and many of them new to science. As in previous contributions, the figures are clear and dainty.

A. L. S.

Fungi from Dominica, Ser. 12^a.—RAFAEL CIFERRI and R. G. FRAGOSO (*Tom. cit.* 323-34, 13 text-figs.). The authors give a further contribution to the fungus-flora of the Dominican Republic. Most of the species are new to science. Two new genera of Hyphomycetes are described—*Bactridiopsis* and *Peyronella*. The new species are illustrated as before.

A. L. S.

Fungi of Mushroom Beds.—F. C. STEWART ("*Oedocephalum fimetarium* and *Peziza vesiculosa* var. *saccata* in Mushroom Beds," *Mycologia*, 1927, 19, 184-7). The mushroom beds in some instances contained bean-and-leaves compost, which

became overgrown by a fawn-coloured mould, later determined as *Edocephalum fimetarium* Sacc. Later, numerous *Peziza* cups were formed round the outside of the beds, but exclusively on areas overgrown by the conidial fungus. Edibility tests of the *Peziza* indicated that, though non-poisonous, it had no value as an esculent. A. L. S.

Distribution of Micromycetes.—J. LIND ("The Geographical Distribution of Some Arctic Micromycetes," *Det. Kgl. Danske Vidensk. Selskab. Biol. Medd.*, 1927, 6, 1-45). The author has made a study of micromycetes on dead or living plants in the arctic regions, especially in Spitsbergen. He decides that the arctic-alpine species must assuredly have been the first immigrants into Spitsbergen, that they must have followed close on the ice border as it receded northward. Other species have probably been carried by the wind. It is reckoned that 195 endophytic micromycetes are at present known to be present in Spitsbergen. Comparisons are made between the arctic flora and that of high mountains in other parts of the globe. An extensive bibliography on the subject is appended. A. L. S.

Studies in the genus *Fusarium*.—A. S. HORNE and J. H. MITTER ("Factors Determining Septation and other Features in the Section *Discolor*," *Ann. Bot.*, 1927, 41, 519-47, 27 text-figs.) The species or strains selected for experiment belonged mostly to the non-staling type. Differences in septation of the spores were induced by varying the nitrogenous constituent or the hydrogen-ion concentration. Increase of glucose influenced both spore capacity and septation. All the changes of media, etc., are carefully tabulated and correlated with the alterations in the fungus. A. L. S.

Respiration and Water-Content in Higher Fungi.—F. J. RICHARDS (*New Phytologist*, 1927, 26, 187-201, 4 text-figs.). As a result of this investigation Richards found that the rate of respiration in the fungus sporophore bore a definite relation to the water-content. As a rule, Agarics respire at a faster rate than Polypores, the rate being correlated with the water-content. Respiration is slightly less in young specimens. There is no evidence that the rate of respiration is affected by the presence or absence of light. A. L. S.

Structure and Development of the Fungi.—H. C. I. GWYNNE-VAUGHAN and B. BARNES (*Cambridge University Press*, 1927, 1-16, and 1-384, 1 pl., 285 figs.). This book has been prepared by the authors to meet the needs of mycological students in the laboratory. A somewhat short chapter is devoted to the vegetative life and growth of the vegetative body—the mycelium. The main interest, however, lies in the discussion of the reproduction of these plants, which includes a multitude of variations. The different groups and families are gone through, and the work done on the members of the groups—much of it by the authors themselves—is carefully told. There is a helpful chapter on laboratory technique, the result of the authors' experience. Methods of culture preparation and treatment of specimens are fully described. There is a valuable bibliography of papers and books dealt with in the text. A complete index is a great addition to the helpfulness of the book. The many illustrations are clear and illuminate the subject-matter. Many of them are original, others are taken from trustworthy sources. A. L. S.

Disease of Rice.—YOSIKAZU NISIKADU ("Studies on the Rice Blast Disease," *Jap. Journ. Bot.*, 1927, 3, 239-44). The blast disease is a very serious menace to the rice industry of Japan. Nisikadu gives in the present paper a résumé of his work on the disease, already published in Japanese. He traces the cause of the

disease to a fungus *Piricularia Oryzæ*. He made tests of the different varieties of plant-hosts of *Piricularia*, also of plants more or less immune. His attention was mainly concentrated on the pH values of the leaf juice of the plants, and he found that in some cases at least resistance to infection was related to the acidity of the leaf. The season of the year and the quality and quantity of manure are important factors in the spread of the disease. A. L. S.

Parasites of Monocotyledons.—E. W. MASON ("On Species of the Genus *Nigrospora* Zimmermann recorded on Monocotyledons," *Trans. Brit. Mycol. Soc.*, 1927, 12, 152-65, 1 pl.). The genus *Nigrospora*, founded by Zimmermann in 1902, was found growing on the leaves of *Panicum amphibium* in Java. A somewhat similar fungus was described later by Molliard, also as a new genus, *Basisporum*. Mason has examined a large number of species published under a variety of names, but all referable to *Nigrospora*, and he has reduced the number of species to three, which he considers may be provisionally accepted. As far as possible he has examined original material, and has given a history of the species, dividing them into those recorded on banana and coco-nut, on maize, on rice, on sugar-cane, and a few records on other hosts. On the plate are depicted the fructification of the various species dealt with—nine in all. A considerable bibliography is appended. A. L. S.

Vanilla Disease in Ceylon.—T. PETCH and C. RAGNUTHAN ("The Fungi associated with Disease in Vanilla," *Ann. Roy. Bot. Gardens, Peradeniya*, 1927, 10, 181-96, 2 pls.). The paper deals first with the history of the disease, and gives a record of all the fungi that have been reported to occur on vanilla and cause decay. There follows a description of the disease as observed in Ceylon. It begins with the south-west monsoon rains about the middle of May, the first sign being a yellowing of stem and leaves, followed by soft-rot. Four fungi were found on the attacked vanillas, and were studied by the authors in pure cultures. These fungi are described and compared with species recorded by other workers. Infection experiments were carried out, but were not decisive as to the causal agent of the disease. Finally, notes are given on other fungi that were found on vanilla. The fungi determined are figured on the two plates. A. L. S.

Lichens.

British Lichens.—ROBERT PAULSON ("Lichens of the Hereford Foray," *Trans. Brit. Mycol. Soc.*, 1927, 12, 87-90). Ninety-eight species and varieties of lichens are recorded for the various excursions made during the Autumn Foray at Hereford. The ground examined was very varied in character—old woodland, old fences, red sandstone, and an outcrop of Silurian limestone, which provided many species. Paulson has determined one new species, *Bilimbia sublubens*, a diagnosis of which is given, and one new to Britain, *Leptogium cataclystum* (Koerb.) Nyl. It grew on light clay loam of heathland at Dinmore. A. L. S.

New Species of Lichens from Porto Rico—1. Graphidaceæ.—BRUCE FINK (*Mycologia*, 1927, 19, 206-21). The author, who died recently, has begun here the description of lichens collected by himself and others in Porto Rico. The paper deals with a very considerable number belonging to the different genera of the family, preceded by an account of general growth and development. A. L. S.

Study of Cephalodia.—O. V. DARBISHIRE ("Ueber das Wachstum der Cephalodien von *Peltigera aphthosa*," *Ber. Deutsch. Bot. Gesellsch.* 1927, **45**, 221-8, 1 pl.). The author has made a special study of the origin and growth of the cephalodia: first, the superficial hairs entangle the *Nostoc* alga, and after that hyphæ from the *Peltigera* cortex grow into the young cephalodium and form its lower cortex. Later, the hyphæ reach the upper surface and form an upper cortex. The cells of the thallus immediately under the cephalodium are hindered in development, and a hollow space in the tissue results. Darbishire discusses the relation between the *Peltigera* and the cephalodium; he considers there is here a clear instance of symbiosis and not of parasitism.

A. L. S.

Sarcogyne Thallus.—E. BACHMANN ("Der Thallus der deutschen Sarcogynearten," *Hedwigia*, 1927, **67**, 131-40, 1 pl.). The author here presents a study of *Sarcogyne* species, which he classifies under *Acarospora* rather than under *Biatorrelia*. There are two distinct groups: (1) endolithic—*S. cyclocarpa*, *S. pruinosa* and *S. pusilla*, and (2) exolithic—*S. simplex*, *S. clavus* and *S. regularis*. The endolithic species inhabit limestone and may form a fairly massive thallus embedded in the stone. For the last three, on siliceous stones, Bachmann finds the thallus wide-spreading, dark brown, thin (0.1 mm. thick), undifferentiated in the thinnest portions, but in the thicker possessing a two-celled cortex and a somewhat massive gonidial zone. The gonidia are larger than in the lime species, and it is suggested that they may belong to a different species or race of Chlorophycæ.

A. L. S.

Lichen Biology.—K. GOEBEL ("Morphologische und Biologische Studien. VII. Ein Beitrag zur Biologie der Flechten," *Ann. Jard. Bot. Buitenzorg*, 1926, **36**, 1-83, 2 pls.). Goebel was attracted to this study of lichens by the very large number of epiphytic species that flourished at Tjibodas owing to the moist conditions that prevail there. First he notes the importance of light; only a few light-coloured green species or dark blue-green lichens persist in the shade. The tops of the trees in these dense woods are covered with lichen forms, such as the *Usnea* on *Casuarina* trees; they mingle with the branches and even outnumber them. Two problems were presented: (1) the absorption of water, and (2) aeration through openings in the thallus. As to the former he finds that chondroid strengthening strands, as in *Ramalina* and *Usnea*, serve for water-storage. He notes two types of hyphæ—swollen hyphæ that store water in their walls, and air hyphæ that retain air in the interstices. The dryness of the latter is due to the presence of lichen-acids. Goebel arranges the material of his paper under four headings: (1) The arrangements for the intake of water by capillarity; (2) absorption by swollen hyphæ and conduction through the cell-membrane; (3) open breathing-pores; (4) water reservation in certain genera. Under these different sections are arranged numerous observations, the results of research on various types of lichen both in the field and the laboratory. For instance, in his discussion of aeration organs he gives an account of their recurrence in many different lichens, and also his experiences in testing their absorption of water, etc. In an appendix he discusses the cephalodia of *Peltigera aphthosa* and of *Solorina saccata*.

A. L. S.

Study of Lichen Growth.—E. JENNIE FRY ("The Mechanical Action of Crustaceous Lichens on Substrata of Shale, Schist, Gneiss, Limestone and Obsidian," *Ann. Bot.* 1927, **41**, 437-60, 2 pls., 22 text-figs.). In a previous paper the author gave results of experiments with crustaceous corticolous lichens. She

has continued her study on a series of saxicolous species. After a general account of the relation of growing lichens to the substratum, and the amount of disintegration noted, the methods of experiment are described. Each type of substratum was examined and the action of the hyphal tissues is followed. As in the corticolous species, there was an arching of the tissues below the apothecia, inducing the detachment of minute fragments of the rock. There was also slight disintegration at the margins of the lichen. Experiments with gelatin models of apothecia and thalli on the different rocks as substratum support the theory that the disintegration of the rock is mechanical, as was already proved for a corticolous substratum. On limestone Fry states that certain chemical action goes on, but that, there also, there is mechanical action exerted by the lichen on the rock.

A. L. S.

Rate of Growth of Lichens.—L. PORTER (*Trans. Brit. Mycol. Soc.*, 1927, 12, 149–52). The author records here observation she has made on the growth of lichens, a subject of some controversy. On gooseberry she noted that in the seven years of its life it had acquired a large collection of lichens—*Ramalina*, *Parmeliæ*, *Physciæ* and *Lecideæ*. The extension of the thallus in these different lichens varied from 13 mm. to 50 mm., the latter size in *Parmelia caperata* along a twig. In south-west Ireland the lichens flourish best where exposed to the greatest illumination, which for gooseberry bushes is on the horizontal branches. On beech trees more than 150 years old a specimen of *Parmelia caperata*, which had probably developed from a single centre during 100 years, had an area of about 80 sq. cm., indicating a rate of growth of about 1 cm. per annum.

A. L. S.

Identity of *Cladonia Beaumontii*.—C. A. ROBBINS (*Rhodora*, 1927, 29, 133–8, 1 pl.). The writer has found considerable discrepancy between the descriptions of *Cladonia santensis* and its form *Beaumontii* as given by Tuckerman and in the published account by Wainio in the "Monograph Cladoniarum," II, p. 455. Robbins finds that in Tuckerman's species *C. santensis* there are included seven species as now recognized, as a very wide latitude was allowed to the species. Robbins enumerates these. As to four of them there is no difficulty. The remaining—*C. santensis*, *C. floridana* and *C. Beaumontii*—are here described and contrasted.

A. L. S.

Critical Revision of Hungarian Coniocarpineæ.—ÖDÖN SZATALA ("A Magyarországi Coniocarpineæ-K. Kritikai Feldolgozása," *Ann. Musei Nationalis Hungarici*, 1926, 24, 99–135). The author goes back to Wahlenberg's "Flora Carpathorum" (1819) for the first mention of Coniocarpineæ in Hungary. Since that day many workers have made contributions, as witnessed by the long bibliography cited. Among recent workers quoted are Sántha, Szatala and Timko. Keys are given to genera and species, with microscopic and other details. There are known 40 species and 38 forms, in 8 genera and 3 families—Caliciaceæ, Cypheliaceæ and Sphærophoraceæ.

A. L. S.

East African Lichens.—BRUNO SCHRÖDER ("Zellpflanzen Ostafrikas," *Hedwigia*, 1927, 67, 141–9). Schröder gives a note on the lichens collected by him, and gives a list of his species which were determined by A. Zahlbruckner.

Catalogue of the Lichens of Connecticut.—A. W. EVANS and ROSE MEYROWITZ. (*State Geol. Nat. Hist. Survey*, 1926, Bull. no. 37, 1–48, with index). The report is largely based on material in the Yale Herbarium. An account

is given of the collectors from 1855 onwards. A large number of botanists, especially those interested in ecology, have taken part in providing material for the list, which consists of 28 families, 65 genera and 301 lichen forms. A list of American papers cited is given and also a full index. A. L. S.

Notes on Connecticut Lichens.—ALEXANDER W. EVANS (*Rhodora*, 1927, 29, 97–105). This paper represents a supplement to the one above. Much new territory has been examined, and the lichen forms (species and varieties, etc.) now number 318. Two new species of *Lecanora* were found and have been described by G. K. Merrill. A. L. S.

Myxotheca Hypocreoides.—ROLAND THAXTER ("Note on *Myxotheca hypocreoides* and its Synonymy," *Mycologia*, 1927, 19, 160–4, 2 figs.). The above organism was found by H. Lassen in Venezuela, in 1912–13, on the fronds of *Trichomanes pinnatum*, and was described by Ferdinandsen and Winge as a fungus. Thaxter has collected the plant and has redescribed it. It forms small cushion-like masses (containing spore-bearing asci), which are seated on a subiculum, in the fringe of which are trentepohliaceous algæ. It being evident that the plant was allied to leaf-lichens, specimens were sent to Wainio, who described it as an *Arthonia* (*Arthothelium*) and evidently a variety of *A. candida*, a lichen from Borneo. Krempelhuber had described the Borneo plant as a lichen, *Myriostigma candidum*, nov. gen. et sp. An examination of Farlow's host index revealed another designation of the plant—*Ascomycetella filicina* Ellis and E. V. But it is probable that the American plant is distinct from that recorded in Borneo. A. L. S.

Mycetozoa.

British Mycetozoa.—G. LISTER ("Mycetozoa gathered during the Hereford Foray," *Trans. Brit. Mycol. Soc.*, 1927, 12, 86–87). The character of the ground examined during the several days' excursions is described. The most remarkable finds occurred at Moccas Old Park, on decaying oak trunks half hidden among bracken; thirteen species were collected from one trunk alone, among them *Lycogala conicum*, a new record for the British Isles. In all, 41 species were recorded for the Foray. A list of these is given. A. L. S.

Mycetozoa from Sumatra.—K. B. BOEDYN (Medan) ("Mycetozoa von Sumatra," *Miscellanea Zoologica Sumatrana*, 1927, Medan (Sumatra), 1–3, 1 fig.). Twenty-two species have been identified. Hitherto only one species had been recorded. The author found that the oil palm (*Elaeis guineensis*) was a rich hunting ground for these small organisms, especially at the bases of old leaves. A. L. S.

Mycetozoa from America.—FRANK A. GILBRET ("Notes on Myxomycetes from Eastern Massachusetts," *Rhodora*, 1927, 29, 165–73). The collections were made by Gilbert during the summer and autumn of 1926, and represent 29 genera and 93 species. About 35 of these are common. In summing up, the writer finds that though Eastern Massachusetts is not especially outstanding with regard to Mycetozoa, yet it yields varied and interesting collections if worked intensively. Myxomycetes, he adds, do not necessarily appear in the same vicinity year after year, but are often found only at rare intervals, so that prolonged search is necessary. A. L. S.

TECHNICAL MICROSCOPY.

Application of Microscope to Study of Pigments.—H. GREEN (*Paint, Oil and Chem. Rev.* 1927, **83**, Nos. 10, 15, 21, 25 ; **84**, No. 1 ; through *J. Oil, Col. Chem. Assoc.*, 1927, **10**, 292). To obtain deflocculation the sample is rubbed out in turpentine, dried and mounted in ester gum. Methods are given for distinguishing between basic carbonate and basic sulphate of lead, and between American and French zinc oxides. Photographs in ultra-violet light tend to show that lithopone consists of particles of BaSO_4 and ZnS together with other compound particles of barium sulphate coated with zinc sulphide. A number of micro-chemical tests are also described. A. H.

Microscopic Examination of Sugar Crystals.—P. HONIG (*Arch. Suikerind.*, 1927, **35**, 693–7 ; *Chem. Abstr.*, 1927, **21**, 3281). The microscope can be used to study the effect of water or syrup added to the pan for dissolving up false grain, which has to be carefully done to avoid splitting of large crystals and its attendant disadvantages. Microscopic tests show that high-pressure steam in centrifuges is liable to burst the crystals. Nuclei acting foreign particles may also be detected, and it is shown that ultramarine does not form nuclei for crystals, which is contrary to usual opinions. Photomicrographs are included. A. H.

Microscopic Examination of Iron and Steel.—F. P. GILLIGAN and J. J. CURRAN (*Trans. Am. Soc. Steel Treating*, 1926, **10**, 9–10 ; *Chem. Abstr.*, 1927, **21**, 3179). Deep etch methods, using hydrochloric acid, or hydrochloric acid and sulphuric acid, are described. A. H.

Microscopic Investigational Methods in Cement Research.—F. TIPP-MANN (*Zement*, 1926, **15**, 793–6 ; 812–4 ; *Chem. Abstr.*, 1927, **21**, 3258). A description of the microscopic apparatus necessary. A. H.

Quantitative Microscopic Analysis.—H. L. ALLING and W. G. VALENTINE (*Am. J. Sci.*, 1927, **14**, 50–65 ; through *Chem. Abstr.*, 1927, **21**, 2856–7). By a combination of the norm (chemical composition) and mode (petrological examination), a good idea of the composition of a rock can be obtained. Areas can be better measured by the camera lucida than by the Shand stage method. A. H.

NOTICES OF NEW BOOKS.

Collected Physical Papers.—By Sir Jagadis Chunder Bose, M.A., D.Sc., LL.D., F.R.S., C.S.I., C.I.E. 1927. xiii, 404 pp., 123 figs. Published by Longmans, Green & Co., Ltd., 39 Paternoster Row, London, E.C. 4. Price 10s.

Spectroscopy.—By E. C. C. Baly, C.B.E., M.Sc., F.R.S. Vol. III. Third Edition. 1927. vii, 532 pp., 6 plates, 60 figs. Published by Longmans, Green & Co., Ltd., 39 Paternoster Row, London, E.C. 4. Price 22s. 6d.

An Annotated Flora of the Chicago Area.—By H. S. Pepoon, B.S., M.D. 1927. xxii, 554 pp. Maps and many Illustrations from Photographs of Topographic and Plant Features. Published by The Chicago Academy of Sciences, Illinois.

Enzyklopädie der Mikroskopischen Technik. Third Edition. Volume 3. Nachtblau-Zytasen. Edited by Prof. Dr. Rudolf Krause. 1927. pp. 1591-2444, 74 figs., 14 coloured and 5 black plates. Published by Messrs. Urban & Schwarzenberg, Berlin, N. 24. Price 50 marks.

Faune de France.—Vol. XVI. Polychètes sédentaires. By Pierre Fauvel. 1927. 464 pp., 2004 text-figs. Price 75 francs.

Vol. XVII. Diptères (Brachycères): Asilidæ. By E. Séguay. 1927. 190 pp., 384 text-figs. Price 35 francs.

Published by Paul Lechevalier, 12, Rue de Tournon, Paris (VI^e).

Practical Microscopy.—By F. Shillington Scales. 1926. x, 332 pp., 119 text-figs. and plates. Published by Bailliere, Tindall & Cox, 8 Henrietta Street, London, W.C. 2. Price 8s. 6d.

This work, now in its third edition, is intended for the beginner, and fulfils this purpose very well, although some of the information provided is rather out of date. Much useful advice is given for the selection and purchase of a microscope. The author strongly advocates the choice of an instrument provided with spring fittings to the slides of the coarse adjustment and mechanical stage, so that wear may be periodically taken up. This limits the field of choice considerably, as most microscope manufacturers have now discarded this device, preferring accurately-made slides, which, if not misused, will last for many years. In the introduction, and again further on in the book, the author states that little or no instruction in the use of the microscope is given in the Universities and medical schools. This statement is only too true. It is the exception, especially in medical laboratories, to meet a microscope user who understands how to handle his instrument correctly or even how to take reasonable care of it. The book appears to have been but partially revised, as appliances which have been available for years are described as recent introductions. In the chapter on photomicrography the author recommends "the plates recently brought out by Messrs. Wratten and Wainwright." It must be nearly ten years since the manufacture of these plates was discontinued. No mention is made of panchromatic plates. Apparently orthochromatic plates were the latest advance when this chapter on the technique of the preparation of specimens for the microscope was prepared. Apart from the above criticisms, the book should prove of great service to anyone who takes more than a passing interest in his microscope.

F. V. W.

Principles of Soil Microbiology.—By Selman A. Waksman. 1927. pp. 897, 19 plates. Published by Bailliere, Tindall & Cox, London. Price 45s.

This work is appropriately dedicated to M. W. Beijerinck and S. Winogradsky, whose contributions can well be considered first and foremost in the science of soil microbiology.

Part A describes the occurrence and the methods of differentiation of micro-organisms as they occur in the soil. Part B discusses the isolation, identification, and cultivation of soil micro-organisms, special attention being directed to the autotrophic bacteria which derive their energy from the oxidation of nitrogen, sulphur, selenium, iron or carbon, and the heterotrophic bacteria requiring combined nitrogen. There are also present in the soil bacteria capable of fixing atmospheric nitrogen, reducing nitrates and sulphates, decomposing cellulose, urea, uric or hippuric acids. The non-bacterial micro-organisms also receive attention. In

Parts C and D the chemical activities of micro-organisms and their relationship to soil fertility and soil changes are described. An extensive bibliography is attached. This work forms an exhaustive treatise on the micro-organisms living actually in the soil. G. M. F.

Les Microbes.—By P. G. Charpentier. 1927. 77 pp., 59 plates. Published by Les Editions Rieder, 7 Place Saint Sulpice, Paris. Price fr. 16.50.

This small work serves as an excellent general introduction to the study of microbiology, for not only are pathogenic micro-organisms described, but the rôle which microscopic organisms play in agriculture, in the manufacture of wine, vinegar, cheese and other materials of everyday life, is duly emphasized. The photomicrographs prepared by M. P. Jeantet of the Pasteur Institute, Paris, are undoubtedly the best to be found in any existing work on microbiology. G. M. F.

BOOKS PURCHASED FOR THE LIBRARY.

Die Süsswasser.—Flora Deutschlands, Österreichs und der Schweiz. Edited by Prof. Dr. A. Pascher.

Vol. I. Flagellatæ I. By A. Pascher.—Pantostomatinae, Protomastiginæ, Distomatinae. By E. Lemmermann. 1914. iv, 138 pp., 252 text-figs.

Vol IV. Volvocales (Flagellatæ 4, Chlorophyceæ 1). By A. Pascher. 1927. vi, 506 pp., 451 text-figs.

Vol. V. Tetrasporales, Protococcales. (Chlorophyceæ 2.) By E. Lemmermann and J. Brunnthaler. 1915. iv, 250 pp., 402 text-figs.

Vol. VI. Ulotrichales, Microsporaes, Oedogoniales. (Chlorophyceæ 3.) By W. Heering. 1914. iv, 250 pp., 385 text-figs.

Vol. VII. Siphonales, Siphonocladiales. (Chlorophyceæ 4.) By W. Heering. 1921. iv, 103 pp., 95 text-figs.

Vol. IX. Zygnemales. By O. Borge and A. Pascher. 1913. iv, 51 pp., 89 text-figs.

Vol. XI. Heterokontæ, Phæophyceæ, Rhodophyceæ. By W. Heering. Charales. By W. Migula. 1925. iv, 250 pp., 208 text-figs.

Vol. XII. Cyanophyceæ. By L. Geitler.—Cyanochloridinae=Chlorobacteriaceæ. By L. Geitler and A. Pascher. 1925. viii, 481 pp. 574 text-figs.

Vol. XIV. Bryophyta. (Sphagnales—Bryales—Hepaticæ). By C. H. Warnstorf, W. Mönkemeyer, V. Schiffner. 1914. iv, 222 pp., 500 text-figs.

British Freshwater Algæ.—By G. S. West and F. E. Fritsch. New and Revised Edition, 1927. xviii, 534 pp., 207 text-figs. Published by Cambridge University Press.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, OCTOBER 19TH, 1927, DR. JAMES A. MURRAY, M.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of the following candidates :—

Charles Rowe Killick, Williton.
Herbert Wm. Rhodes, Ilkley.
Professor Alexander Ogg, Cape Town.
Dr. Edward Kirk, Hong Kong.
Sydney Borthwick, London, W. 1.

New Fellows.—The following were elected Ordinary Fellows of the Society :

John A. Long, Leeds.
Watson Kirkconnell, M.A., Winnipeg.

Donations were reported from :

Professor P. G. Charpentier—
“ Les Microbes.”

British Museum—

Catalogue of Lepidoptera Rhopalocera, Part III., Nymphalidæ.
Index Animalium, Part XII.

Messrs. Longmans, Green & Co.—

“ Collected Physical Papers ” (Bose).
“ Spectroscopy ” (Baly).

Chicago Academy of Sciences—

“ Flora of the Chicago Region ” (Pepoon).

Messrs. Urban & Schwarzenberg—

“ Enzyklopädie der Mikroskopischen Technik,” Part III.

Messrs. Bailliere, Tindall & Cox—

“ Principles of Soil Microbiology ” (Waksman).

Dr. M. W. Littlewood—

“Synopsis of Recent Foraminifera of Great Britain” (Williamson).

“Synopsis of the Rotifera” (Hudson and Gosse). 2 vols.

“Synopsis of the Infusoria” (Saville Kent). 2 vols.

Collection of miscellaneous slides.

Mr. S. C. Akehurst—

Library Clock.

Electric Ceiling Bowl.

Votes of thanks were accorded to the donors.

Deaths :—

Mr. H. H. Mortimer. Elected 1918.

Dr. G. C. Karop. Elected 1885.

A vote of condolence with the relatives was passed.

Exhibit.—Mr. D. J. Scourfield exhibited and described a specimen of *Vacuolaria virescens*, the only species of Chloromonadales known to occur in the British Isles and rarely recorded.

The following papers were read :—

Mr. Conrad Beck, C.B.E., F.R.M.S.

“Note on Diatom Structure and Resolution.”

Professor H. Graham Cannon, M.A., D.Sc., F.L.S., F.R.M.S., and Dr. A. J. Grove, M.A., D.Sc.

“Aerating and Circulating Apparatus for Aquaria and General Use.”

Dr. A. J. Grove, M.A., D.Sc.

“A Simply Made Hot Plate for Flattening Paraffin Sections.”

Dr. Oskar Heimstadt.

“Stereoscopic Vision with the Microscope.”

Professor Paul Vonwiller.

“Microscopy with Incident Light and its Application to Living Objects.”

Mr. Douglas P. Wilson, B.Sc.

“Note on a Method of Obtaining Long Working Distances with Low-Power Objectives.”

Votes of thanks were accorded to the contributors of the above papers, and to Mr. Scourfield for his exhibit.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, NOVEMBER 16TH, 1927, DR. JAMES A. MURRAY, M.D., F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

New Fellows.—The following were balloted for and duly elected Ordinary Fellows of the Society :—

Sydney Borthwick.
Charles Rowe Killick, M.B.
Edward Kirk, M.D.
Alexander Ogg, B.Sc., Ph.D.
Herbert William Rhodes.

Donations were reported from :—

Paul Lechevalier—

“Faune de France.” (Polychètes Sédentaires : Fauvel.) (Diptères, Brachycères : Ségué.)

Professor J. Arthur Thomson—

“Alcyonaires, des Campagnes Scientifiques du Prince Albert de Monaco.”

Votes of thanks were accorded to the donors.

The Deaths were reported of—

M. J. Allan. Elected 1913.
J. Rudd Leeson. Elected 1914.
George Potter. Elected 1867.
Percy E. Radley. Elected 1898.

The Fellows expressed their condolence with the relatives by standing in silence.

Exhibit.—Mr. W. E. Watson Baker exhibited an efficient and inexpensive microscope for use in schools.

The following papers were read and discussed :—

Dr. James A. Murray, F.R.S.—

“Methods for the Demonstration of Bacteria in Frozen Sections.”

Miss K. F. M. Kirby, B.Sc.—

“Plastid Development in *Osmunda* Spores.”

Dr. R. J. Ludford, Ph.D., D.Sc., F.R.M.S.—

“Cell Migration in Tissue Cultures and its Relation to the Repair of Injuries to the Epidermis.”

Votes of thanks were accorded to the authors of the foregoing communications, and to Mr. Watson Baker for his exhibit. Votes of thanks were also accorded to the following firms for the loan of microscopes: Messrs. Watson & Sons, Messrs. R. & J. Beck, and Messrs. J. W. Ogilvy & Co.

The business proceedings then terminated.

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